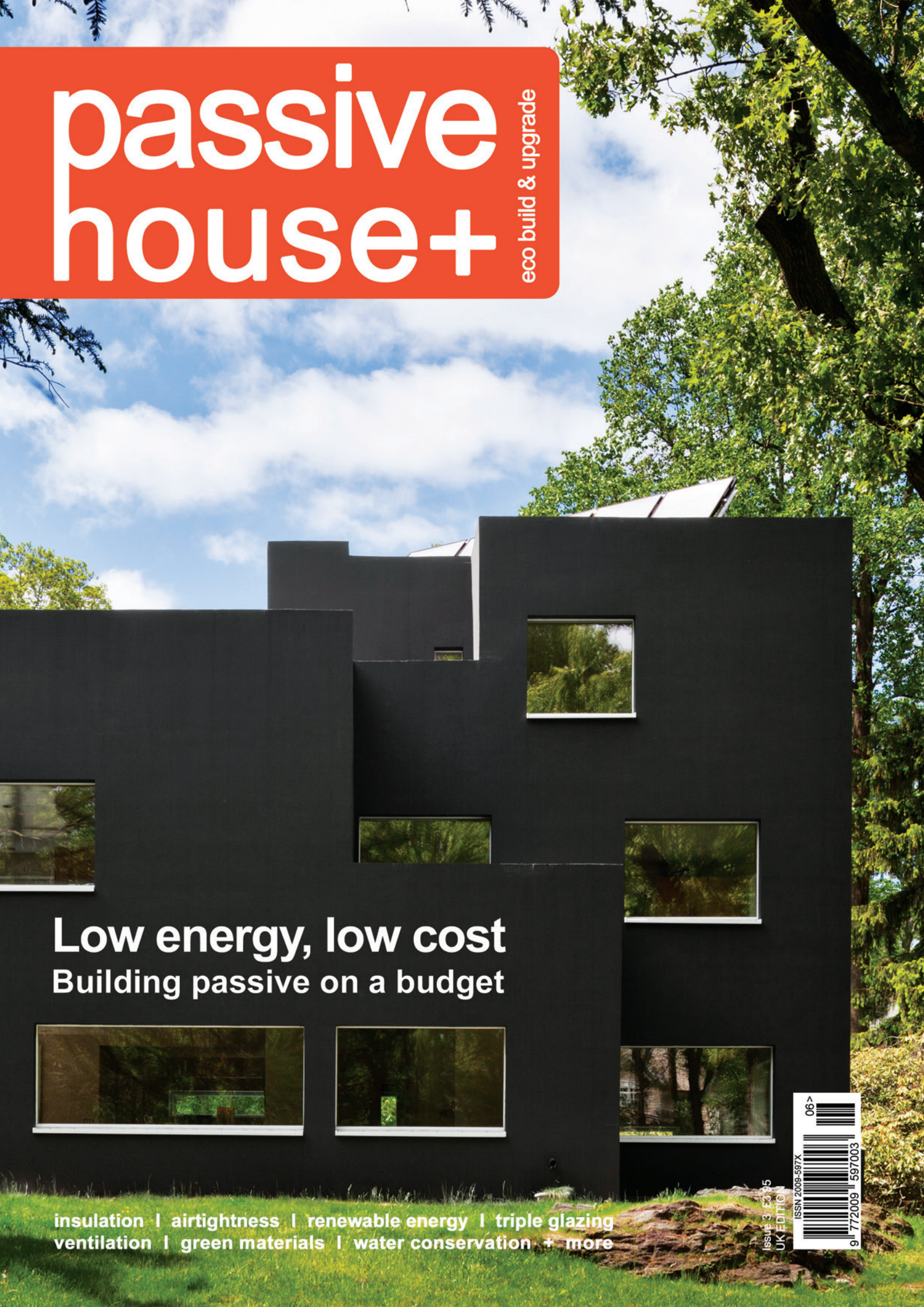

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editor's letter

The cost of building to the passive house standard runs through several of the articles in this issue. It's a much misunderstood subject, and it's one that must be tackled if passive house is to gain acceptance as a viable building performance target.

If we want to establish the cost of building passive, we must first work out what benchmark we're comparing against. We might compare against the worst buildings it's legally possible to build – buildings that scrape minimum compliance with building regulations – but we'd get very different results if we were building in Ireland or the UK, given that Irish energy efficiency regulations have moved far ahead of the UK. For new homes in Ireland, it's arguable whether passive house adds any additional cost, give the legal requirement to hit 60% energy and carbon reductions compared to 2005 standards under the Irish version of Part L of the building regulations. Some well-informed designers argue – perhaps a little glibly – that Ireland's latest version of Part L has effectively made passive house the minimum standard.

We must also ensure we're comparing like with like in the case of materials and finishes. A high spec passive house should be compared with a high spec – but thermally bog-standard – building. As our case studies often show, many of the people who build passive houses also choose green building materials, and install everything from renewable energy systems to rainwater harvesting – the sorts of measures which may increase construction costs in order to yield economic, environmental and comfort dividends over time.

Conversely when it comes to building form we shouldn't compare like with like. If a building is designed without the constraints of absolute energy demand targets, its form is likely to be less compact, meaning higher spend on construction materials. In this regard the percentage reductions of building regulations are no substitute for exacting kilowatt hour per square meter values. Irish Part L only asks that, say, the H-shaped bungalow of your dreams must be 60% more energy efficient than the same H-shaped bungalow would have been if built to 2005 regs.

Accurate pricing – a hot button issue in the construction industry in recent years – is also key. On one hand some contractors may be conservative and bid in at absurdly high prices for passive houses because of the unknown element. On the other hand they may underestimate what's involved – or gamble that the client can be persuaded to "value engineer" the building away from the standard – and bid in too low. There are stories of inexperienced contractors going bust or leaving subcontractors and suppliers unpaid because they bid in too low and ended up unable to afford to complete the building.

There are several other elements to the cost debate – such as the reductions achieved through economies of scale and the creation of standard details, or the opportunity to specify smaller heating systems that passive house affords. But we must also remember that the longer term cost benefits go beyond mere reductions in energy bills. By creating building fabric that essentially eliminates infiltration or thermal bridging, we're protecting that fabric from the elements, leaving us with buildings that are built to last. And what could be more cost-effective than that?

Regards,
the editor

2012 Business magazine of the year - Irish Magazine Awards

Jeff Colley:
winner - green leader award - Green Awards 2010

Construct Ireland:
winner - green communications award - Green Awards 2010

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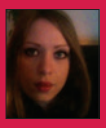

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Cover: Williams-Levant retrofit
Photograph: Doug McDonald

ABC certificate pending

Heating, hot water, solar integration and ventilation in one place with the Vitovent 300-F

The new floor standing Vitovent 300-F mechanical ventilation unit is ideal for Passivhaus projects as the heat recovery keeps up to 95 percent of the extracted heat inside the building.

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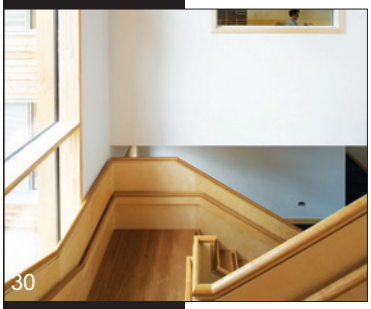


News

51 home passive development approved for London

Circle Housing Group and Climate Energy Homes have teamed up for the development of a 51-unit residential passive house development in east London.

The London Borough of Havering planning committee approved the development in February and work is expected to start this month (June).

“We are really excited about this new development as it has the potential to reduce our customers’ heating and hot water costs by up to 80% each year," said Helen Wilson of Circle Housing Group.

"This scheme will set a precedent for Circle to continue to deliver highly energy efficient properties and I look forward to seeing more passive house developments in the future.”

The development, designed by Maccreanor Lavington Architects, comprises three and four bedroom houses and one, two and three bedroom apartments together with amenity space, car and cycle parking, landscaping, pumping station and associated works. Located in the Rainham West Site Specific Allocations area, the 1.15ha brownfield site was formerly occupied by a Carpet Right warehouse.

The development will utilise the Ecotech build systems from Climate Energy Homes. The factory built closed timber frames are supplied to site complete with breather membranes, insulation and plasterboard, with Secured By Design triple-glazed windows and doors all pre-installed to ensure airtightness.

“Our unique Ecotech build systems have been benchmarked against industry standard costs and are shown to cost up to 10% less than less well insulated traditional houses and take around half the time to build," said Climate Energy Homes CEO Christine Hynes.

Architype moves forward on UK's largest residential passive house scheme

Architype has received planning permission for two landmark passive house schemes, including the UK’s largest passive scheme to date, and a passive house research building at the University of East Anglia.

The firm said that the 150 house Kingstone project in Herefordshire is the first stage in realising an "ambitious vision" to transform both the quality and the sustainability of developer housing in the UK. The Architype-designed Norwich Research Park Enterprise Centre at UEA – which is aiming for a BREEAM Outstanding rating in addition to passive house certification – was also recently approved.

Architype said it had been frustrated by the lack of interest from mainstream developers in housing design quality, particularly in rural areas, and the lack of real progress in the housing industry towards more sustainable solutions.

The firm said that by integrating it into design from first principles, passive house can be achieved within standard budgets.

Architype director Jonathan Hines and Swedish businessman Lars Carlsson have established a new company called ArchiHaus, which is acting as the client and developer on the project, and is working closely with Architype and Churchman Landscape Architects.

Besides the passive house standard, the Kingstone project also aims to create a "sense of community and a distinctively rural character" and to achieve "higher standards at a competitive cost".

To create a rural character, the scheme features clusters of houses set within a landscape of winding lanes and native hedgerows, swales and wetlands, and generous green community open space with natural play, allotments and traditional orchards.

The design of the houses has been optimised to enable full off-site prefabrication using standard modules and efficient panel sizes.

Architype held a number of community consultation workshops, and incorporated many ideas suggested by local people, including a new cycle/foot path to create a safe connection between the north and south parts of the village, a new pedestrian crossing over the adjacent main road, and new village allotments.

Click here to view an online gallery featuring illustrations of these projects.

This content is exclusively available to our digital subscribers.

(pictured) An aerial view illustration of the Kingstone project, and an illustration of the Norwich Research Park Enterprise Centre

News

Passivhaus Trust reveals awards shortlist

Nine projects have been shortlisted for the second UK Passivhaus Awards, the only UK awards dedicated to the passive house standard, with a focus on as-built performance.

The UK Passivhaus Awards, now in their second year, celebrate the design and performance of certified passive buildings in the UK. Organised by the Passivhaus Trust, the awards aim to highlight the achievements of passive house pioneers and show that the standard can be applied to any building type and context to create beautiful buildings.

This year's three award categories feature a variety of projects from different and challenging contexts that successfully achieved the standard. Projects on this year's shortlist have broken passive house stereotypes, and the list includes schemes designed in conservation areas, a house that uses the innovative Brettstapel timber construction technique, and one of the UK's first social cohousing projects.

The shortlisted projects are:

Private Housing (sponsored by Ecology Building Society): Crossway, Richard Hawkes Architecture; Plummerswood, Gaia Architects; Totnes Passivhaus, Passivhaus Homes Ltd;

Social Housing (sponsored by Kingspan): Ditchingham Passivhaus, Parsons & Whittley; Lancaster Cohousing Project, Eco Arc Architects; Racecourse Passivhaus Bungalows, Gentoo;

Non-domestic (sponsored by Munster Joinery): Green Base, Simmonds Mills Architects; Canolfan Hyddgen, JPW Construction; Interserve Leicester offices, Interserve.

Phase one of the awards was judged by Hattie Hartman (sustainability editor, The Architects' Journal); Jon Bootland (chief executive, Passivhaus Trust); Lynne Sullivan, OBE (co-founding partner, Sustainable by Design) and Nick Grant (technical director, Passivhaus Trust).

"The Passivhaus Trust is to be commended for its awards programme which requires performance data with every entry," Hattie Hartmann said. "This year's shortlist includes some excellent residential exemplars both in affordable housing and individual homes. The pipeline of non-domestic passive house projects is slower, and we hope to see an increased number of projects next year."

The winning projects will be decided on the basis of a vote by Passivhaus Trust members and members of the audience at the awards ceremony, which will take place on 4 July at the residence of the Austrian Ambassador in London.

(clockwise from left) the nine shortlisted projects include Green Base, Racecourse Passivhaus bungalows and the brettstapel-built Plummerswood dwelling

Ecology offers 1.25% passive house mortgage discount

Ecology Building Society has launched an updated C-Change sustainable homes scheme, offering interest rate discounts of up to 1.25% on mortgages for homes that meet the passive house standard.

The C-Change sustainable homes discounts also apply to Enerphit, the Passive House Institute's standard for retrofits. The society has also increased its maximum loan-to-value on residential and shared ownership properties to 90%, to enable it to support more people to build, buy or renovate sustainably.

Commenting on the launch of the new discounts Ecology chief executive Paul Ellis said: "Our C-Change sustainable homes discounts have shown that mortgage lenders have a vital role to play in improving the energy efficiency of our homes. Five years since we first launched this scheme, the challenges of cutting the carbon footprint of our housing stock are even clearer, and it's the right time for us to acknowledge the proven effectiveness of the passive house and Enerphit standards in achieving warm, comfortable, healthy homes that are affordable to heat."

Chris Herring, director of Green Building Store and chair of the Passivhaus Trust, commented: "We congratulate Ecology Building Society for this forward-thinking and progressive step. By giving buildings built to passive house and Enerphit standards their highest level of mortgage discount, they will help support the development of genuine low energy construction in the UK."

C-Change sustainable homes also offers discounts for properties achieving an energy performance certificate (EPC) rating of B or above, EcoHomes 'very good' or 'excellent', Code for Sustainable Homes Level 4 and above, and AECB silver or gold standard.

News

Low energy visitor centre built with Kingspan wall and roof systems

A new visitor centre in Telford has achieved "outstanding levels of thermal and airtightness performance" according to Kingspan, who supplied wall and roofing systems for the building.

Telford Town Park Visitor Centre, constructed by Wygar Construction Co Ltd of Walsall, provides a cafe, meeting/class room space and bicycle hire to the town park, and forms the first stage of a £250 million regeneration plan for the Southwater area by Telford and Wrekin Council.

The building's bird-inspired design uses reclaimed local stone and wooden cladding as part of the façade which reflects the habitat and wildlife supported within the park.

The Kingspan TEK building system's propriety jointing system is designed to create an effective seal, allowing it to achieve airtightness results of 0.58 $m^3/hr/m^2$. The Unidek Aero System is installed using a PU foam sealant between joints to minimise air leakage. At Telford Visitor Centre a high performance vapour control layer was installed inside both systems.

Kingspan said that the TEK building system features a highly insulated core, uninterrupted by studwork, which minimises thermal bridging. On the visitor centre it was supplemented with a 60mm external layer of high performance Kingspan ThermaWall TW55 Insulation Board, achieving a final wall U-value of 0.14.

Kingspan also said the the Unidek Aero roofing system delivers a "worst case" roof U-value of 0.14. The system's SIP panel design also "virtually eliminates" thermal bridging by avoiding the use of through timbers.

Project architect Kim Anderson commented: "The TEK and Unidek Systems were the perfect choice for the visitor centre. Their SIP structure allowed them to be quickly and simply installed and their overall airtightness and thermal efficiency meant we could achieve the required level of performance, without having to compromise on internal space."

The Town Park Visitor Centre includes a range of other features such as triple glazed windows, mechanical heat recovery ventilation and a solar PV array. Lowfield Timber Frames acted as Kingspan's "delivery partner" on the project.

17th passive house conference hears of international growth

One thousand energy efficiency enthusiasts gathered in Frankfurt, Germany on 19 and 20 April for the 17th annual International Passive House Conference.

As part of the conference Frank Juner, director of the Frankfurt's largest housing association, discussed the 1,600 apartments the group has built to the passive house standard.

The performance of passive house buildings in different climates was one of the conference's main themes. Speakers presented projects in Estonia, Mexico, New Zealand and Sicily, among other countries.

Meanwhile, Ralf Bermich and Robert Persch of the Environmental Authority in Heidelberg, Germany, presented their project to turn the premises of a former freight train station into the new 116 hectare Bahnstadt quarter, which is being built to the passive house standard. In a few years, it is estimated that some 12,000 people will be living and working in this new city district.

A model of the world's first passive house factory in Harbin, China was also available for viewing: it will include 5,000 square metres of office space and a 20,000 square metre production hall. "We are extremely pleased that interest in passive house is also increasing in those countries undergoing construction booms," said Professor Wolfgang Feist, director of the Passive House Institute.

The passive house pioneer award was presented to a zero-energy house built in Denmark during the 1970s by Vagn Korsgaard and Torben Esbensen. To recognise modern day pioneers, the launch of a new competition, the 2014 Passive House Award, was also announced. A wide range of passive house certified components, from triple-glazed windows to heat recovery ventilation units, were also exhibited at the conference.

On Sunday 21 April, conference participants visited passive house projects throughout Frankfurt, including schools, offices, terraced homes and social housing.

"Efficiency is the key to the success of the energy revolution," Professor Wolfgang Feist said. "If we are able to increase the energy efficiency of buildings to passive house level on a large scale, then sustainable energy supply will become possible, even with rising prosperity worldwide."

(above) A model of the world's first passive house factory in Harbin was presented at the conference

News

NBT system used on ‘carbon negative’ social housing scheme

Natural Building Technologies’ Pavawall system has been used to construct Sinclair Meadows in South Shields, the UK’s first 'carbon negative' social housing community. According to NBT, the natural woodfibre-based wall system "delivers high levels of thermal insulation and airtightness, as well as excellent breathability". Sinclair Meadows is a community of 21 homes, comprising nine three-bedroom houses and 12 two-bedroom apartments.

The project, which was constructed by Galliford Try Partnerships North and funded by the Homes Communities Agency, is designed to exceed Level 6 of the Code for Sustainable Homes by ultimately saving more CO_2 than it produces.

The Pavawall system comprises a continuous layer of high performance woodfibre boards installed on the outside of the 220mm deep timber frame structures, with NBT Pavaflex woodfibre batts between the studs fully filling the space. The woodfibre boards feature tongue and groove edges to enhance wind tightness and airtightness.

Internally, the Pavawall system is completed by an OSB layer on the internal face of the timber frame, with Siga airtightness tapes applied over the joints for airtightness. Plasterboard is installed over battens on the OSB racking and finished with a breathable paint. Externally the system is completed with a combination of natural lime render applied directly to the wood fibre, and larch timber cladding. The system delivers a U-value of 0.14.

NBT said that the system’s breathability means that the structure of the homes will self-regulate moisture level, minimising the risk of interstitial condensation, protecting the integrity of the building fabric and the health of residents.

The walls are complemented by 500mm of loft insulation and airtight detailing on the internal ceilings. All windows are triple-glazed.

A community biomass boiler provides heating and hot water, and the development features 700 square metres of photovoltaic panels. A rainwater harvesting system provides non-potable water for use in toilet flushing, washing machines and garden irrigation.

The calculated design carbon saving of the development is approximately 16 tonnes per annum, which will effectively wipe out the carbon emissions of the construction within three years of completion, according to NBT.

Special offer on Optiwin passive windows for our readers

Low energy window specialist Ambiwood is offering Passive House Plus readers its Optiwin Alphawin windows for the same cost as its Optiwin Alu2Wood units for a limited time. The company has developed the offer celebrate the launch of their new website, ambiwood.co.uk, and the second anniversary of their entry to the UK market.

While both ranges are certified by the Passive House Institute, Alphawin has an A rating from the institute and features edge-to-edge glass, flush frame detailing and concealed mechanisms. Alphawin windows typically cost 25-30% more than Alu2Wood windows, and can deliver an overall U-value as good as 0.64.

Ambiwood is a third generation Wolohan family company with a manufacturing base in Ireland. It manufactures, supplies and fits Optiwin passive house certified window systems. The company's Conor Ryan said this is the "Ambiwood way — no subcontractors are used and a family member is always on site during fitting.”

He said that the company's complete chain of custody is one of the reasons Bere Architects chose Ambiwood to manufacture and supply windows for the firm's newest passive house project at Exmouth Market, London.

"Justin Bere of Bere Architects told me as far as he is aware this is unique in the UK and ensures all the required attention to detailing is delivered," he said. "This month we are actually celebrating two years in the UK marketplace and our Optiwin systems have been in production for well over 10 years." Ambiwood is also the passive house window supplier to Stoke on Trent's Centre of Refurbishment Excellence project.

Conor Ryan concluded: "Our stable of products has been delivering energy savings to all types of projects from retrofit, commercial, low energy and passive buildings for well over 10 years. Optiwin’s certified passive projects over the years have included England and Ireland’s first passive houses and Ireland’s first commercial passive building."

Readers can avail of Ambiwood's offer if orders are booked by 31 July. To avail of the offer, email conor@ambiwood.co.uk with Passive House Plus in the subject line.

Optiwin windows also feature at the Salthill passive house by Passive House Builders, profiled on page 50 of this issue.

(above) Passive House Institute founder Prof Wolfgang Feist pictured with Ambiwood director Conor Ryan

News

Ensure continuity of insulation, London Insulation warns

Insulation must be precisely installed in order to avoid needless heat loss, a leading insulation contractor has warned.

According to Rafael Demilata of London Insulation, theoretical energy performance levels risk being compromised by poorly installed insulation – particularly in the case of insulating between rafters and joists.

“Blown, sprayed or softer materials such as mineral wool, cellulose or spray foam are best suited for use in such spaces as they can more easily expand to fill any gaps,” he said.

He said that rigid board insulations are best employed for uninterrupted use either above or below rafters or joists.

Demilata – also the managing director of Bow Tie Construction – told Passive House Plus that his experience as a builder has been that insulation work often causes unnecessary delays in the UK. "90% of construction projects are delayed," he said. "We're ready – we have methods in place to ensure insulation work is done efficiently and methodically. On an average domestic project, we're able to save three to four working days simply by being prepared, having the right tools, and knowing which innovative products to use.

“Insulation and airtightness installing are labour intensive processes to get right. A typical builder will take too long to install the insulation, and won't necessarily install it correctly,” he said. “We can turn around approximately 170 square metres of insulation work in a day, using two skilled installers – and it's done right.”

Demilata – a member of the Passivhaus Trust, and the Green Register of construction professionals – points out that the company's knowledge of building regulations and low energy building in general means that their services include not only installation, but consultancy.

"We work with spray foam insulation, Warmcel, woodfibre and any standard off-the-shelf insulation," said Demilata. "We have a practical understanding of how these materials can work together, to deliver the best result."

(pictured) How do you insulate this? Complex roof structures can prove very tricky to insulate thoroughly

Munster joinery wins Green Product Award

Cork-based window manufacturer Munster Joinery has won the green product award at the Green Awards, an Irish awards programme set up to recognise environmental excellence.

“We’re proud to be recipients of the 2013 green product award,” the company’s Gemma Ring told Passive House Plus. “This prestigious awards programme does great work in encouraging Irish companies to use innovative techniques to grow their businesses in a sustainable manner.”

According to Ring, Munster Joinery is acutely aware of its environmental responsibilities: “Buildings contribute massively to the carbon emissions that give rise to global warming,” she said. “Windows and doors form an important part of the building fabric and we have optimised the thermal performance of all our products.” The company has developed passive house suitable components throughout its ranges to enable designers and builders to achieve low to zero carbon project, and has achieved passive house certification on five window systems including uPVC, aluminium and aluclad frames.

“We have also looked to reducing the environmental impact of our huge energy requirements,” said Ring. “We have invested heavily in green technologies to meet these requirements and reduce our carbon footprint.” In 2009 Munster Joinery began investing heavily in renewables – installing two wind turbines with an electrical output of 4.2 megawatts, and commissioning a biomass CHP plant fuelled by sawdust and timber off cuts from the joinery. The plant is capable of generating up to 12 megawatts of thermal energy which is used for space heating and process heating throughout the plant. The CHP plant also produces up to 2.8 megawatts of electricity, completing a package of renewable energy generation that has greatly reduced the company’s carbon footprint and energy costs.

“At Munster Joinery we strive to provide an energy efficient product from an environmentally conscious source together with an efficient service,” Ring said.

“We are delighted that this award has recognised the passion with which we have designed and developed our passive window range” she concluded.

(above) Munster Joinery’s Gemma Ring (front row, fourth from left) amongst the other winners at the Green Awards

News

Back to Earth finish work on Devon passive house

Devon-based sustainable building material suppliers Back to Earth have just finished work on their first passive house. The dwelling, also in Devon, was constructed with a timber frame insulated with various types of woodfibre. Back to Earth supplied all the woodfibre insulation, airtightness products and renders on the project, and were also responsible for carrying out the condensation risk analysis and much of the design work.

The house's walls feature 300mm of Unger-Diffutherm UdiFlex flexible woodfibre insulation, with 140mm UdiFront Diffutherm external woodfibre insulation board outside the frame. The roof has a similar build-up, and all the opaque elements of the building envelope have U-values around 0.1. The house's blower door test produced an impressive result of 0.265 air changes per hour.

The project team built a home office first, separate to the house, as a test-bed to ensure airtightness and other detailing was correct before starting on the main residence.

A 100 square metre basement houses both a small gas boiler and the house's heat recovery ventilation system, while the house has a ten square metre solar thermal array too. The homeowners moved in at the end of March, and report that very little gas has been used to date. The house was also designed specifically to accommodate the needs of the family's disabled child.

The project is undergoing passive house certification by Plymouth-based low energy consultancy Warm, and Back to Earth's Chris Brookman told Passive House Plus he expects the certificate to be issued in the next few weeks.

Brookman gives credit to contractor Hollyford Developments for the success of the project, their first passive house. "To get an airtightness of 0.265 is quite an achievement," he said.

(pictured) the Devon-based house features woodfibre insulation between & external to the building's timber framed walls and roof

Award-winning Irish passive house on the market

Passive house enthusiasts looking for a holiday home in Ireland's sunny south east take note: a turnkey, award-winning passive house is on the market.

The first of eight certified passive houses located at Grange Lough in Rosslare Strand, Co Wexford, Ireland is now for sale at the reduced figure of €358,000 – equivalent to £304,000 at the time of writing.

Developer Michael Bennett said this price offers "exceptional value considering that the house comes to market fully furnished".

The timber frame house was the overall winner of the Irish Isover Energy Efficiency Award in 2011. The walls and roof feature Isover Metac mineral wool insulation and Intello vapour barriers. The house also includes triple-glazed Munster Joinery windows, solar thermal panels and a heat recovery ventilation system. The timber frame was constructed by Wexford-based Shoalwater Timber Frame, and the house has an airtightness of 0.51 air changes per hour.

The house is of storey-and-a-half construction, and is within walking distance of a blue flag beach, while golf and other leisure facilities are nearby.

With a floor area of 168 square metres, it has three bedrooms, two of which have their own ensuites, and a study-cum-fourth bedroom. Fully paved and landscaped gardens and external areas are provided throughout, as is an external store.

For more information about the house visit http://bit.ly/13xU7LU.

News

SheepWool Insulation products launched into UK

SheepWool Insulation has launched a range of new 100% sheep wool products to the UK.

This includes the company's new range of Premium Rolls. "These are 100% pure sheep wool insulation rolls, which are ideal for use in walls, rafters and floors, and due to the particularly high density of these rolls, they are very superior in their performance, both thermally and acoustically," said Aisling MacDonald of SheepWool Insulation.

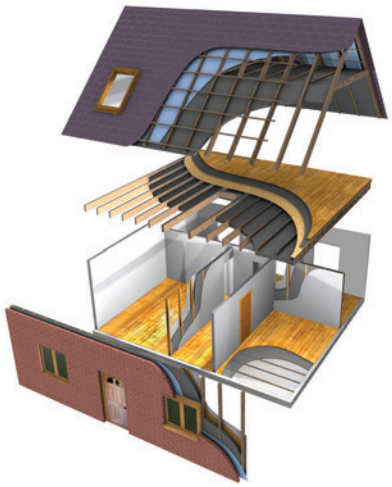
Also new to the market is the SheepWool range of 'Silent Floor' acoustic products. This range consists of underlay rolls, for use under carpets and wooden floors. One product in the range has a "protective breathable paper to maximize performance", MacDonald said, adding that the range also includes a joist strip.

"Again all of these products contain only 100% pure wool, have excellent performance and are long lasting. Notwithstanding the fact of course, that by their own nature they are totally natural and breathable," MacDonald said.

"For thousands of years, sheep have been able to adapt to even the harshest of environments, as their wool protects them through hot, cold, damp and dry seasons. Therefore it is no wonder that SheepWool Insulation is so ideal for any home."

SheepWool Insulation are also launching their range of membranes and airtightness products, which MacDonald said ensures a "total package suitable for use with the insulation and acoustic underlay products".

(below) An illustration showing some of the applications for SheepWool Insulation products; (top) SheepWool Insulation tightly packed into the slope of a pitched roof



ProAir finds that innovation is the key to growth

Irish heat recovery ventilation manufacturer ProAir is undergoing a series of big changes as the Galway-based company expands further into the UK market and invests in research and development. The company's David McHugh told Passive House Plus that ProAir was "reinventing" itself as it emerged from recession.

He said the company had spent the past few years focusing on research and development, with some financial support from Enterprise Ireland. "We are the lead company and project coordinator of a multi-company R&D project in the UK which is being sponsored by the UK Department of Energy and Climate Change," said McHugh. "This project has just started and its purpose is to develop the next generation combined heat pump and HRV system with a substantial increase in overall efficiency."

In addition to this, McHugh said the company is close to commercialising "a whole suite of HRV products and accessories aimed at the ultra-low-energy residential construction sector," and that he expects one or more of the company's products to achieve passive house certification in the coming months.

"It is likely to be the first HRV unit to be tested and certified by the new £100,000 facility set up in the BRE HQ in Watford," McHugh said, adding that he hopes to announce further details of developments within the company over the coming months.

The company also launched its new UK website, proair-systems.co.uk, recently.

(above) ProAir managing director David McHugh

Call for entries to international passive house award

The Darmstadt-based Passive House Institute is looking for entries to its newly announced competition, the 2014 Passive House Award. The award will recognise projects that take an energy-efficiency-first approach to building. It will reward "innovative projects demonstrating the great potential and versatility offered by passive house solutions".

Competition entries can range in scope from single buildings to entire districts or regions. Submissions will be evaluated by an independent jury of highly qualified experts based on their energy efficiency and sustainable energy supply concepts along with other features such as cost-effectiveness and architectural design.

The competition is supported by the EU-funded project Passreg (passive house regions with renewable energies). The winner will be announced at the 2014 International Passive House Conference.

The Passive House Institute is currently seeking sponsors for the awards. Sponsors will be featured on the Passive House Award website, in a poster exhibition showcasing the winners at the 2014 International Passive House Conference and a variety of other events throughout Europe, as well as on pamphlets, brochures and other Passive House Institute publications. Further information is available at www.passivehouse-award.org

News

Screed innovations key for sustainability — Smet

Selecting the right floor screed can play a key role in a building's sustainability, a leading screed supplier has said.

According to Joris Smet, director of Smet Building Products Ltd, the company's recently launched German-made LiteFlo floor screed combines improved thermal performance with reduced environmental impact, making it possible to install underfloor heating in applications where it may have been ruled out, such as retrofits and multi-storey timber frame buildings.

"LiteFlo is unique, in that it's the first pumpable lightweight flowing screed available," Joris Smet said. "It's made from specially selected aggregates, which makes it 30% lighter than conventional flowing screeds and 70% lighter than sand and cement, meaning less material is required per square metre."

"Light weight flowing screed can be placed in reduced thicknesses, delivering improved floor U-values, and naturally has substantially lower embodied carbon emissions than a sand & cement screed," he said.

A light weight alpha hemihydrate screed, LiteFlo is a self-levelling screed based on calcium sulphate. The company said because it is pump-applied, it is ideal for timber frame builds, suspended timber floors, tower buildings, balconies, renovation projects and over acoustic or thermal insulation. Smet said that LiteFlo's low weight enabled underfloor heating to be installed in multi-storey timber frame buildings, and that its reduced thicknesses meant underfloor heating could be retrofitted without substantially raising floor levels.

LiteFlo may be applied as a levelling screed directly onto a load bearing floor, unbonded on a separating barrier (polythene), or as a floating floor, and is particularly suited in conjunction with underfloor heating or cavity floors. LiteFlo should be covered with a floor finish such as tiles, linoleum, parquet, cork or carpet. If a cement based adhesive or smoothing compound is required the surface of the screed must first be sealed, using an appropriate acrylic primer/sealer.

LiteFlo is supplied to site in pre-mixed bags or site silos and is designed for application at thicknesses of between 20 and 90 mm. LiteFlo complies with EN 13813: 2002 and is CE marked.

Smet has a pool of professional installers who supply the product across the UK and Ireland.

(above) A self-levelling floor screed, LiteFlo can be installed to exacting tolerances, enabling the installation of perfectly level high quality floor finishes

Ecowin launches triple-glazed window with less frame, more glass

Scottish energy-efficient window supplier Ecowin is now supplying the Gaulhofer Glassline window system, the latest triple-glazed timber-aluminium window from Gaulhofer, one of Austria's leading window manufacturers.

Ecowin's Thomas Froehlich said the product offers 10% more solar gain because it has less frame, which he said will also make it popular with architects.

"The U-value is certainly improved because you have more glass and less frame," he said, adding that the glass offers an "optimum" window U-Value of 0.75.

"There is nobody who really does this kind of timber aluminium window in the UK," he said.

"It's perfectly suitable for passive house."

He said because of the small frame area, on a glazed wall it's impossible to tell which sections are openable and which aren't.

Ecowin was set up in April 2012 and is a UK importer for Gaulhofer windows. Froehlich said that all Gaulhofer's timber windows are supplied in spruce or larch that is solely grown in sustainably-managed Austrian forests.

He said that Gaulhofer produced the Glassline window "to be able to provide the passive house market without compromising on design."

(centre) A cutaway section of the Glassline 86 Pure timber aluclad window

News

Installation as important as window quality, says Ecohaus Internorm

Quality window installation is a crucial part of any low energy build, yet it is often overlooked compared to a window's technical performance, according to leading passive house window specialists Ecohaus Internorm.

"Rarely does a site manager or airtightness champion sing the praises of the installation of supply only windows into a passive house or low carbon build," said Mark Lineham of Ecohaus Internorm. "These builds require windows manufactured and installed to exacting standards and yet the majority of window manufacturers supply only. Architects and clients are rightly preoccupied with window performance and meticulous detailing of junctions but can only hope and pray this is executed correctly and accurately at the point of installation. Why introduce risk?"

Lineham warned that the current standard of workmanship by many UK tradespeople may fall short of their European counterparts. "Incorrectly installed windows will result in failed air tests, subsequent disruptive rework and additional costs," he said. "This is a direct result of inadequate training, poor understanding of passive house principles and an underlying assumption that such installations are easy.

"EcoHaus Internorm take full ownership of the supply chain and installation of the market-leading Internorm windows. The combined use of Illbruck airtightness tape, window seal foam and Compriband tape has BBA Certification and is subsequently included in our 10 year installation warranty," he said. "Couple this with Internorm's 30 year quality assurance warranty on all products, and our clients benefit from an unrivalled overall warranty package."

According to Lineham, EcoHaus Internorm has yet to fail an airtightness test on a passive house project. "Our insistence that installations must be done by our Internorm technicians continues to resonate with our architect, main contractor and self build clients," he said. "We also have a technician on site for air tests as standard procedure for passive house builds. We see it as our professional obligation to Internorm and our clients to provide a seamless service and single accountable point of contact.

"Other high performance window manufacturers should reconsider their warranty obligations and extend this to not only to the product but the installation also. Clients are investing heavily in high performance windows and they shouldn't be shortchanged."

EcoHaus Internorm was awarded Internorm's No 1 UK Partner for 2012.

Advanced Timbercraft 'bucks trend' with expansion & innovation

Leading Northern Irish timber frame manufacturers Advanced Timbercraft (ATC) has welcomed new multi-disciplinary design practice McGurran Associates to their new office complex. Practice principal Kevin McGurran and ATC managing director Neil Orr have had a "longstanding and successful working relationship over a 15 year period".

"This more formal trading relationship will allow ATC to offer full planning and architectural services to clients attracted to the concept of a 'one-stop shop' for their new bespoke home or to developers who wish to future-proof their housing stock," explained Neil Orr.

He said that ATC has always pushed the boundaries of innovation and development, and has continually incorporated new ideas and products into its systems to improve performance and longevity.

"We are now awaiting the installation of a new timber frame manufacturing line which will allow us to maintain our excellent quality and increase production capabilities. To accommodate this new line we are also expanding our factory. This growth has been stimulated as we have been engaging with progressive forward-thinking clients and developers," Orr said.

"The individual client today likes the idea of a one-stop shop in regards to the building process with a high performing comfortable and healthy home as the result. It is also a very exciting to work alongside new housing developers who share our passion to build future-proof new homes for all."

Kevin McGurran added: "Having identified the forward thinking nature of ATC and found it struck a chord with own ethos for sustainable building design, we felt that a closer working relationship would benefit everyone. How better to do this than to be located on site where we can now promote a more streamlined building process?"

(pictured: l-r) McGurran Associates principal Kevin McGurran pictured with Advanced Timbercraft MD Neil Orr

News

Kent concrete shed turned into low energy classroom

Canterbury based ecological architecture firm Conker Conservation has just completed work on the deep retrofit of an uninsulated school building at Brockhill Park Performing Arts Academy in Hythe, Kent.

Paul Mallion of Conker Conservation told Passive House Plus his strategy to retrofit the building was to construct a Warmcel-insulated timber frame outside the existing concrete portal frame.

The building once served as an agricultural shed before being converted into a classroom that required 24/7 heating to be habitable — it had just a single skin of blockwork and single glazing.

The retrofit was designed according to passive house principles, though it isn't aiming for certification. Mallion told Passive House Plus that the building is now estimated to consume between 25 and 30 kWh/m^2/yr for space heating. "Compared to what it was that's an outstanding improvement," he said.

The building's windows are triple-glazed timber aluclad Rationel Aura Plus units, supplied by Passivlux, another Canterbury company. Though the units are not passive house certified, Mallion described them as a "really good value for money product."

"They have a very large area of glass relative to the frame," he said, which helps to improve the overall U-value. The U-value of the glazing only is 0.57.

The only element of the building fabric the team couldn't fully tackle was the floor — they couldn't raise it without losing headroom, and they couldn't dig it up because it was important structurally, so only 50mm of insulation was installed under a Fermacell plasterboard deck.

Mallion said the project offers a repeatable exemplar to many concrete agricultural sheds across the UK. The project also features Fakro triple glazed rooflights, and a newly launched Vent Axia mechanical heat recovery ventilation system.

(pictured) the original building was uninsulated. A Warmcel insulated timber frame was built externally, complete with triple glazed Rationel Aura Plus windows from Passivlux

Heliotherm achieve COP of 7.29 in heat pump test

Heliotherm have come out on top of a recent test carried out on 46 different heat pump installations across Europe with an annual coefficient of performance (ACOP) of 7.29.

The EU-funded Sepemo project, standing for seasonal performance and monitoring, was set up to gather information on the real life performance and reliability of heat pumps in the field on a day-to-day basis and was carried out by the Austrian Institute of Technology. Forty six heat pumps were tested across six European countries.

The AIT certified Heliotherm not only with an "unusually high ACOP", but also noted that the heat pump ran error free during the testing period.

The Heliotherm direct evaporating heat pump heated was installed in 2003 with underfloor and wall heating distribution systems. For the purpose of the study, the Austrian Institute of Technology monitored its performance in a 200 square metre family home between May 2011 and April 2012.

"This is a wonderful acknowledgment of our strategy, which does not only limit us to observing laboratory values, but also on the results of everyday use. Thereby, reliability and efficiency in practice are exactly what the end user is mostly interested in," said Heliotherm CEO Andreas Bangheri.

There are 25,000 Heliotherm heat pump installations Europe-wide. The company produces heat pumps ranging from 6kW to 500kW in both ground source and air-to-water units.

(above) The house where a Heliotherm heat pump (inset) was tested as part of the Sepemo project

News

Fronius launching range of new inverters in 2013

Austrian inverter manufacturer Fronius is launching a "significant number of new and innovative products" this year.

“The entire PV market is currently in a state of flux,” said Martin Hackl, head of the company's solar electronics division. “In 2013, we will continue to demonstrate that people can put their faith in us and that Fronius is a strong partner. We have a wide range of new and innovative products, offering our customers technological leaps as well as the usual high quality associated with Fronius.”

The new range of products includes the Fronius Galvo, a single-phase electrically-isolated transformer inverter with power categories ranging from 1.5 to 3.1kW. Fronius said the Galvo is ideal for households and small PV installations. The company is also launching the Fronius Symo, a three-phase transformerless inverter that comes in power categories of 3.0, 3.7 and 4.5 kW. The Syno features an "innovative hinged design" that makes assembly and installation easy, and it can be installed indoors or outdoors.

Other new products include single-phase inverters in the 5kW category, and the Fronius Agilo Outdoor, which the company said is the first central inverter in its power categories (75 and 100kW) that can be fully installed and commissioned by the installer, and serviced and repaired by a Fronius service partner. The inverter is designed for industrial and commercial applications. The Agilo Outdoor can be set up outdoors without requiring any protection.

Fronius is also launching Fronius Solar.Web 2, a free monitoring system with "intuitive and detailed" visualisation of data.

Fronius International is an Austrian company with headquarters in Pettenbach and other sites in Wels, Thalheim, Steinhaus and Sattledt. With 3,257 employees worldwide, the company is active in the fields of battery charging systems, welding technology and solar electronics. Around 94% of its products are exported through 19 international Fronius subsidiaries and sales partners in over 60 countries. The company's solar electronics division has been in existence for 20 years.

"The combination of high-quality parts, excellent workmanship, the data gained from our endurance tests, and our experience together with our constant drive to keep on improving our products is what makes us the quality leader," said Hackl.

According to Fronius the new Galvo inverter is particularly suitable for private consumption systems due to its integrated energy management function.

DVS launches passive house certified roof windows

Daylight and Ventilation Solutions (DVS) has launched two new Lamilux passive house certified rooflights to the UK market. DVS exclusively represents Lamilux in the UK.

FEenergysave is a "highly energy-efficient" rooflight for flat roofs and has achieved the highest 'Advanced' rating on its Passive House Institute certificate. It is the world's first Passive House Institute-certified skylight for flat roofs.

Designed for larger areas of roof glazing, the PR60energysave system also achieved an 'Advanced' rating and was the first sloped glazing component to achieve Passive House Institute certification.

"These products were only launched in August and have already been extremely well received by architects and passive house designers," said Daniel Boughton of DVS.

Both products are triple-glazed and feature argon-filled cavities, two low e-coatings and a warm edge Superspacer system.

The FEenergysave has a U-value of 0.84 W/m^{2}K for the glazed element when installed horizontally (the USL value, a way of expressing U-values for skylights), and 0.61 W/m^{2}K for the frame (Uf value). The PR60energysave unit has an overall U-value of 0.81W/m^{2}K (UCWi value, a measure for inclined curtain walls).

(above) Passive House Institute senior scientist Dr Benjamin Krick (centre) presents the certificate for PR60 energysave to Lamilux CEO Dr Heinrich Strunz (left) and Technical Manager Joachim Hessemer (right); a section view of the PR60 energysave

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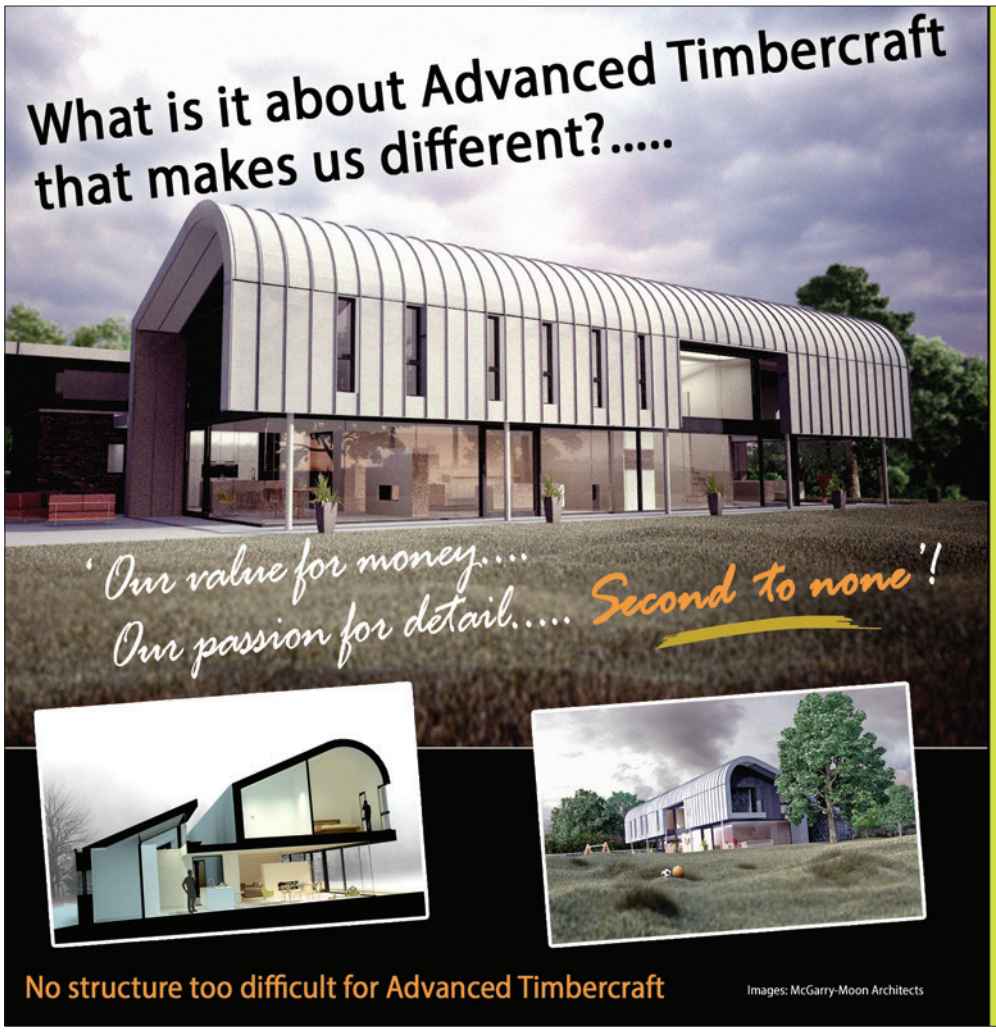

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Stage (tick box)

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Commencement notice ☐

Project imperatives (tick box)

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Why we offer better lending terms for passive house & Enerphit

One of the main obstacles to sustainable building has been the banking sector's failure to factor issues like energy efficiency into their lending terms. A breakthrough has emerged in the UK, with Ecology Building Society's decision to offer discounted lending rates on passive house and Enerphit buildings. Ecology CEO ***Paul Ellis*** *explains the rationale behind the move.*

Innovation is the key to business success – so you'd think we'd be happy to be the only financial institution that offers a special passive house mortgage scheme. But we're not.

Ecology's aim is to improve the environment by supporting ecological building practices and sustainable communities. For us, passive house is at the forefront of these practices: the methodology is proven to achieve sustainable, comfortable, healthy homes that are affordable to heat. That's why we recently gave the standards pride of place in our C-Change mortgage discount scheme, to give a further incentive to borrowers to achieve the passive house or Enerphit standards.

But our model isn't just about providing direct support. We want other lenders to follow where we lead. In this way, we've been instrumental in developing the self-build finance market, something that didn't exist 33 years ago when we were established. Now more than 20 UK building societies alone will consider self-build projects and the government recognises the potential for self-build to address our chronic housing shortage.

Will passive houses be the next big thing for mortgage providers? We hope so, but change takes time. Our experience shows that mainstream lenders are often deterred by innovative or unconventional projects. They see them as more risky and their one-size-fits-all approach often results in 'computer says no' decisions. That's why our human approach to assessing projects individually is important – it enables us to build a case for the mortgageability of new building methods.

There's an argument that passive house properties, being highly energy efficient, could present less of a credit risk. As energy prices rise and more and more households suffer fuel poverty, affordability will become less about the initial cost of a build or purchase and more about the running costs of a property. A study of 71,000 home loans across the United States found that mortgages on homes with energy efficiency certifications were, on average, 32% less likely to default than loans on homes with no energy efficiency improvements. We don't have equivalent data for the UK, nor is it likely we could assemble this data across the market, but when we have sufficient data we'll report on the performance of passive house properties in Ecology's loan book. What we do know is that Ecology's overall arrears rates are a lot lower than the lending industry as a whole – last year we didn't take a single property into possession.

Can the passive house industry do more to encourage lenders to actively support passive house? Certainly the more evidence we gather about actual energy performance, the more we can demonstrate the credibility of the methodology and the affordability gains. The more we raise the profile of passive house, especially with wider public audiences, the more it will be seen as a sensible, not radical approach to building, and less likely to scare mainstream lenders. Collecting data on the sale prices of passive house properties will also be important, to demonstrate that a robust resale market exists for these properties.

> "A study of 71,000 home loans across the United States found that mortgages on energy efficient homes were, on average, 32% less likely to default"

We will continue to argue both the business case and the moral case for our financial institutions to support green building, including passive house. If the big banks really want to return to their socially useful roots, they need to think about how they can incentivise homeowners to build or renovate to high energy efficiency standards. Profit should not be the only (or arguably the first) priority for their business decisions: the welfare of people and the environment matters too.

Follow us on Twitter and tweet your thoughts to @phplusmag

Here's a sample of tweets and threads of tweets that caught our eye recently.

The cost of building passive
Passive House Plus @phplusmag: One Irish #passivehouse in our next issue = €109 per sq ft / circa £960 per sq m. Can anyone better it?
Leigh caller @leighcaller: Long Sutton #passivhaus delivered for £900 per sq meter!! Suspect the cost to the contractor was higher, but is this cheapest in UK?
PMC Architects @PMCarchitects: we delivered a certified passivehouse for £885 per sq/meter in Northern Ireland.

The power of a thermal image
Ross Elliott @Elliott_Homesol: Seeing Passivhaus in a whole new way #passivehouse

From Darmstadt
International Passive House Association @the_iPHA: The number of certified passive house designers has reached 3,000!
Prof Wolfgang Feist @WolfgangFeist: That is a nice short report from the 17th Passive House Conference - seen from the opposite part of the globe http://j.mp/11UHx8F

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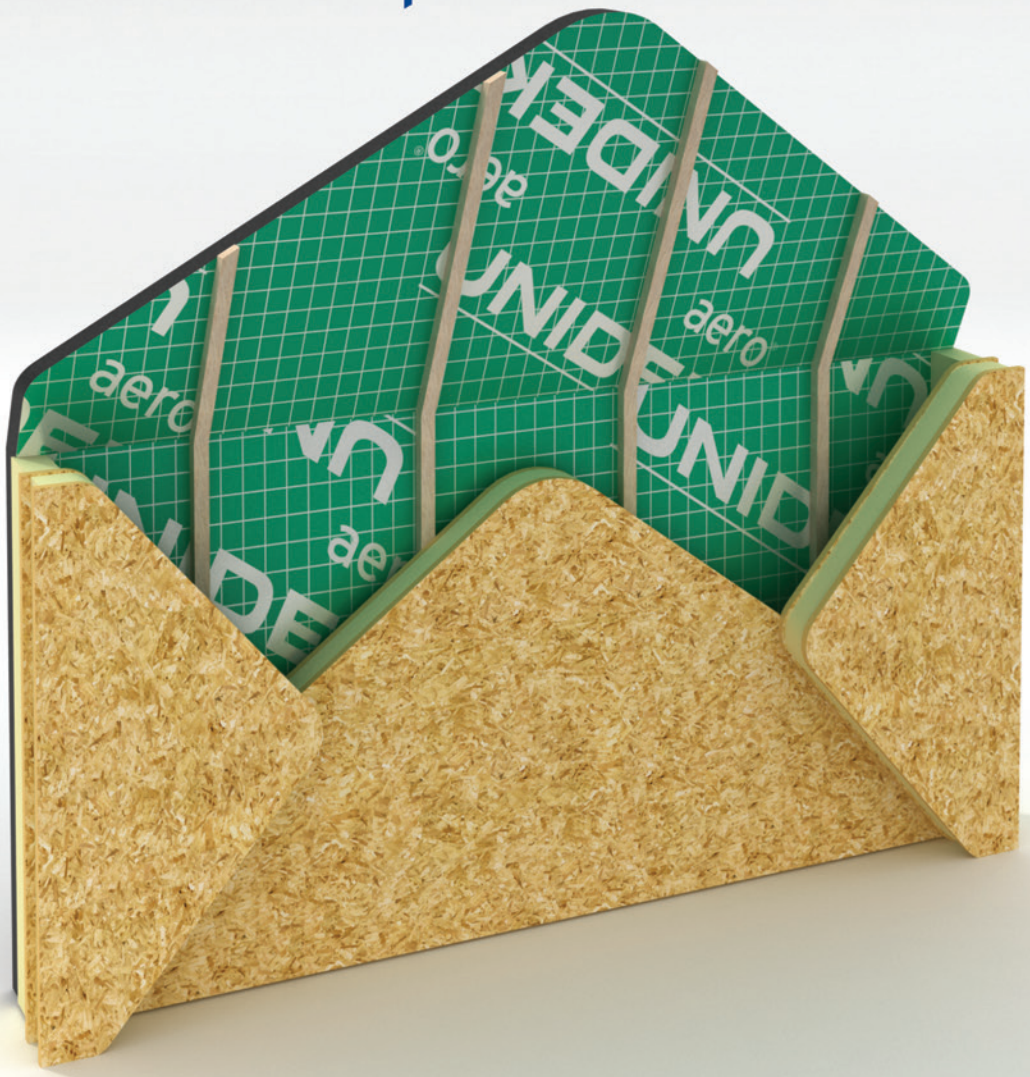

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Photos: courtesy of Autark Home

INTERNATIONAL SELECTION

Picking from some of the best current sustainable design the world has to offer, we profile a floating passive house currently moored in the Netherlands, a ground-breaking timber hybrid tower in Austria, a multi unit passive scheme in Malmö, and an Enerphit upgrade to a brutalist Connecticut home originally designed by one of Frank Lloyd Wright's colleagues.

Floating passive house, Maastricht

Here's something a bit different — a floating passive house in Maastricht, the Netherlands. And not only does it float, but the 'Autarkhome' produces its own electricity, collects its own drinking water and even cleans its own wastewater. Built from reinforced concrete with rigid foam insulation externally, the house has everything you'd expect from a passive house: triple-glazing, heat recovery ventilation and exceptional airtightness.

But this off-grid pioneer takes things way further: for a start, it can collect water right from the surrounding river and treat it for drinking with osmosis, sand and UV filters. Twenty four solar photovoltaic cells provide electricity, with a biodiesel generator acting as a back-up on cloudy days. Solar thermal collectors feature too, and the house even has its own wastewater treatment facility.

This prototype was conceived by renewables firm IBC Solar BV and Maastricht-based architect Pieter Kromwiljk along with a long list of partners, and it has proved so popular that IBC is now planning to mass produce it. Construction took nine months, but the company says once mass production starts Autarkhomes could be built in less than half that time.

IBC Solar BV's Peter Meijers told Renewable Energy magazine last year that the design could be particularly popular in places where there are plenty of rivers and lakes but limited land space for housing. ▶

Williams-Levant retrofit, Connecticut

Can you turn a 1934 modernist home into a passive house without destroying its character? Judge for yourself. One time Frank Lloyd Wright employee Barry Byrne built this brutalist classic in 1934 for the pianist and comedian Oscar Levant. At one stage it was threatened by demolition, but passive house designers and contractors MudaGreen have wrapped it with recycled glass insulation and achieved Enerphit certification, the new Passive House Institute standard for retrofit.

But the house is more than just energy efficient: MudaGreen's Doug Mcdonald avoided the use of "red list" chemicals, chose fast-growing bamboo for the floors and installed solar thermal panels for hot water. He says the original design of the house was "amazing even for today's family", and that he only had to remove two interior walls during the refit. He describes the house as "carbon free" because it runs on a renewables-only electricity tariff, so the only carbon burned is by its owners' cars. The concrete frame that once acted as a giant thermal bridge now provides thermal mass that helps to smooth temperatures inside by absorbing heat and releasing it slowly. The landscaping requires no fertiliser or additional water beyond rainfall.

Has it changed the character of the house? Some will say yes. But historic houses need to be liveable in order to survive into the future, and this retrofit seems to update — rather than alter — the house's modernist character. ▶

Photos: Doug McDonald

(bottom left and main photo) Before and after photos of this 1930's modernist home, renovated to passive house standards by Doug Mcdonald (left) of MudaGreen

Only two interior walls were removed from the original design, one of which was in the kitchen (below)

Salongen 35, Malmö, Sweden

The western harbour of Malmö was once an industrial district of factories and shipyards, but today it is a hub for urban regeneration. The University of Malmö opened here in 1998, and three years later the area welcomed the Bo01 (Live01) housing exhibition, which saw 350 apartments constructed to showcase a quality, high density urban district rich with public spaces and architectural diversity.

Bo01 is largely wind-powered, cycle tracks criss-cross the zone, and buildings here are heated by a combination of roof-mounted solar panels and Malmö's citywide district heating network. There's an ecological approach to landscaping too, with green roofs, a network of waterways and nesting boxes for birds. The area has its critics though — some say it has become too reliant on cars, that overglazing means some buildings use too much heat, and that property here is only affordable to the rich.

In 2009 veteran passive house architects Kjellgren Kaminsky won a competition to develop a four unit residential passive house complex, called Salongen 35, on Bo01's last vacant site. Aside from its energy efficiency, the development boasts other green features: solar thermal panels, green roofs and walls, FSC-certified timber throughout, low water taps and greywater re-cycling. Each unit is also clad with a different material — plaster, cement board or wood — to give it a unique character. ▶

Photos: courtesy of KKA

LifeCycleTower ONE

Words: Paul McNally, architect

LCT ONE was completed in 2012 and is an example of architect Hermann Kaufmann's goal of developing timber construction over the course of decades of working with the material. Kaufmann has been designing passive houses since the 1990s in the harsh climate of Voralberg, Austria.

This office building is an eight-storey low energy (13 kWh/m²/yr) hybrid construction clad in a beautiful reflective skin. The detailing is crisp and minimal. Modulation of the facade is restrained to an expression of the vertical circulation core, and framing of the ground floor entrance portico.

The timber columns and beams are expressed inside, softening the aesthetic along with a playful use of colour which highlights certain aspects of structure, sometimes accentuating it and sometimes suppressing it.

LCT ONE is a pioneering building which pushes the limits in several ways. At eight storeys, it is the maximum allowable for timber construction. For Hermann Kaufmann architects it is a research project for their "Lifecycle Tower" wood construction system which seeks to unlock multi-storey timber construction for the international market.

The wood-concrete composite ribbed ceiling is the main development that allows the higher build by separating floors, with wooden beams cast into a concrete filled mould. Due to the high degree of prefabrication, the construction process is fast, with ceiling elements fitted in just five minutes.

Want to know more?

Click here to view additional information on these projects, including an online gallery featuring illustrations, photographs, and project overview panels.

This content is exclusively available to our digital subscribers.

Photos: Norman A. Müller / Darko Todorovic Photography / Cree

(below) LCT ONE is the world's first eight-storey unenclosed wood-hybrid building; (bottom right) exterior walls being lowered into place during construction. Ceiling and walls were prefabricated and delivered to the site ready to install so it was possible to assemble the eight floors of the office building in just eight days

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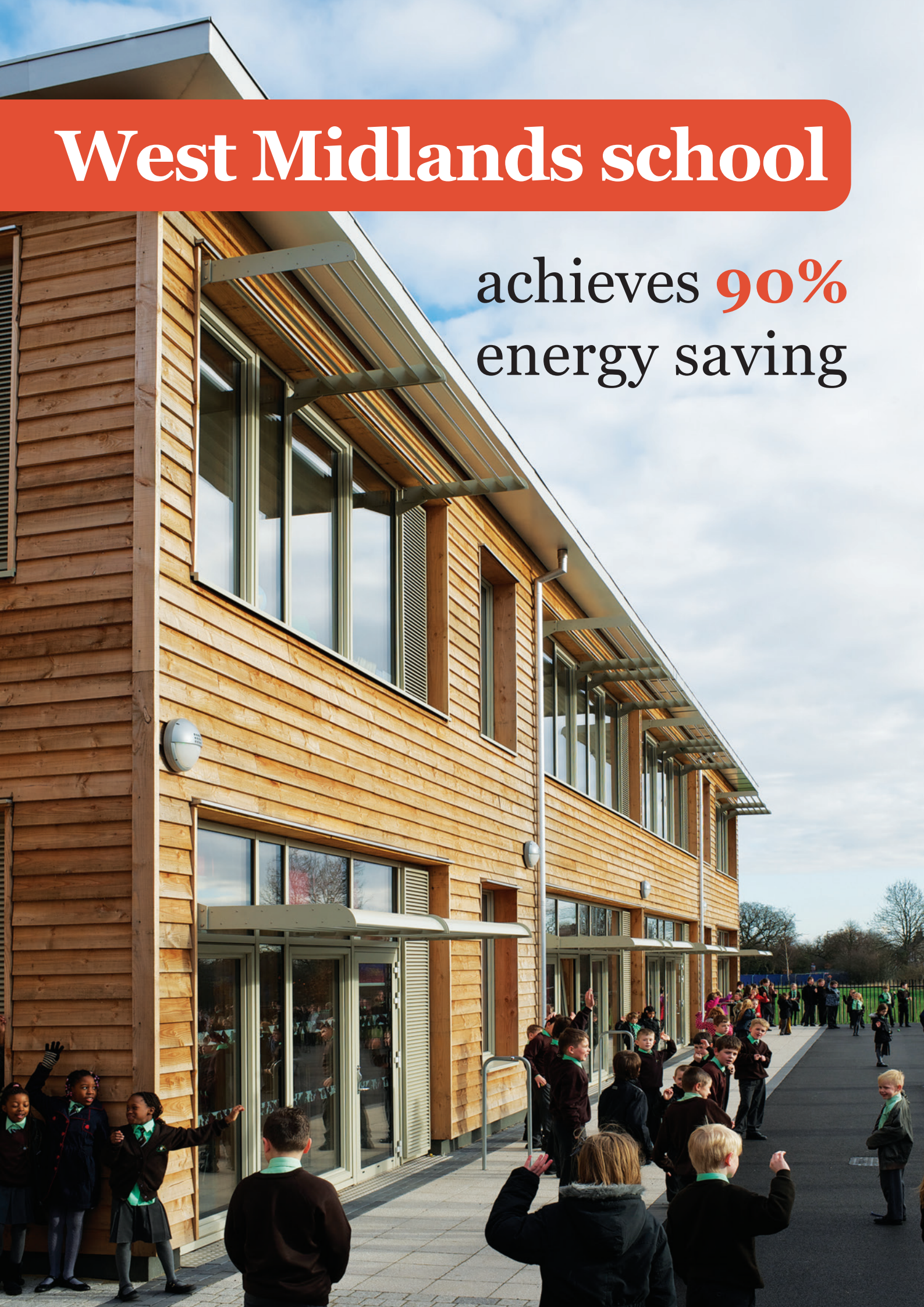


Photos: Leigh Simpson

Building a passive house school is a big achievement, but the team behind Oakmeadow Primary School in Wolverhampton have done something even more formidable — they built one when they weren't even asked to, and they did it for a conventional budget.

Words: Lenny Antonelli

The passive house standard may have been developed for homes first, but since the early 1990s it has grown into a badge of honour for all sorts of buildings: student residences, offices, supermarkets, churches and community centres.

Schools are catching on too. As we start to think more about the type of buildings that are most conducive to learning, schools are beginning to see passive house as the ticket to a comfortable teaching environment— the antithesis of the cold, dark and dingy schools many of us grew up in, or the prefabs that dot school yards today.

Passive House Plus has already featured two pioneering passive house schools built last year in Ireland, but the UK caught on to this trend even earlier.

In 2011, leading London & Hereford-based green architects Architype designed two certified passive house primary schools – Oakmeadow and Bushbury Hill — for Wolverhampton City Council. But while many low energy schools have been experimental prototypes with big budgets to play around with, Oakmeadow and Bushbury Hill – which respectively won the non-domestic award at the UK Passivhaus Awards and the RIBA sustainability award in 2012 – were a bit different.

At first the city council had no intention of building passive house schools— until Architype said they could meet the standard for the same budget and within the same timeframe.

The council had previously contracted Architype to design St Luke's Primary School, the first in the country to achieve an 'excellent' rating under the Building Research Establishment's environmental assessment method (BREEAM).

Architect Jonathan Hines says designing passive house principles into a building from the start keeps costs down.

He says architects often spend so much of their budget on design features like complex shapes and different claddings that it doesn't leave enough money for sustainability. If you build an "elegant simple building", he says, your budget can stretch further.

"We believe you can prioritise efficiency but also create beautiful buildings," he says.

Oakmeadow's headteacher Sara Morris says Architype's enthusiasm convinced everyone to aim for the passive house standard, which she admits she knew little about before the build.

The 1960s building that housed the school before was in a bad way and its roof had suffered from vandalism. "It just was in a poor state of repair," Sara says.

Architype has a long history of building with timber — Jonathan Hines calls it a "fundamentally sustainable material"— and at Oakmeadow Irish timber frame manufacturer Cygnum supplied the frame. It was the company's first passive house project.

Cygnum says on its website that it does not source timber from forests that are converted to plantation or non-forest use, or where conservation is threatened, timber is harvested illegally or civil rights are breached. The company says its policy is to "ensure compliance" with sustainable forestry programs like FSC and PEFC.

At Oakmeadow, the timber frame walls and roof were insulated on site with Warmcel cellulose insulation, which manufacturer Excel Fibre Technology says combines "unrivalled" airtightness with breathability.

Pupils even got to bring their old newspapers in for recycling into cellulose fibres that were used to insulate the new school.

Airtightness in the walls and roof is provided by a layer of OSB boards sealed with Pro Clima tapes. Cygnum's main engineer on the project, Mark Smith, says that a "level of paranoia" was the key to achieving airtightness.

"It was a massive learning curve for us anyway. This being our first passive [project], we spent a lot of time going through the detail and design," he says.

Though based in Cork, Smith says that Cygnum is doing much of its work in the UK market, which he reckons is becoming increasingly open-minded about timber frame, passive and sustainable projects.

He commends Architype's 'fabric first' approach to reducing a building's energy demand, and says the concept of the Oakmeadow building is ultimately quite simple, though he jokes: "It didn't feel it at the time!"

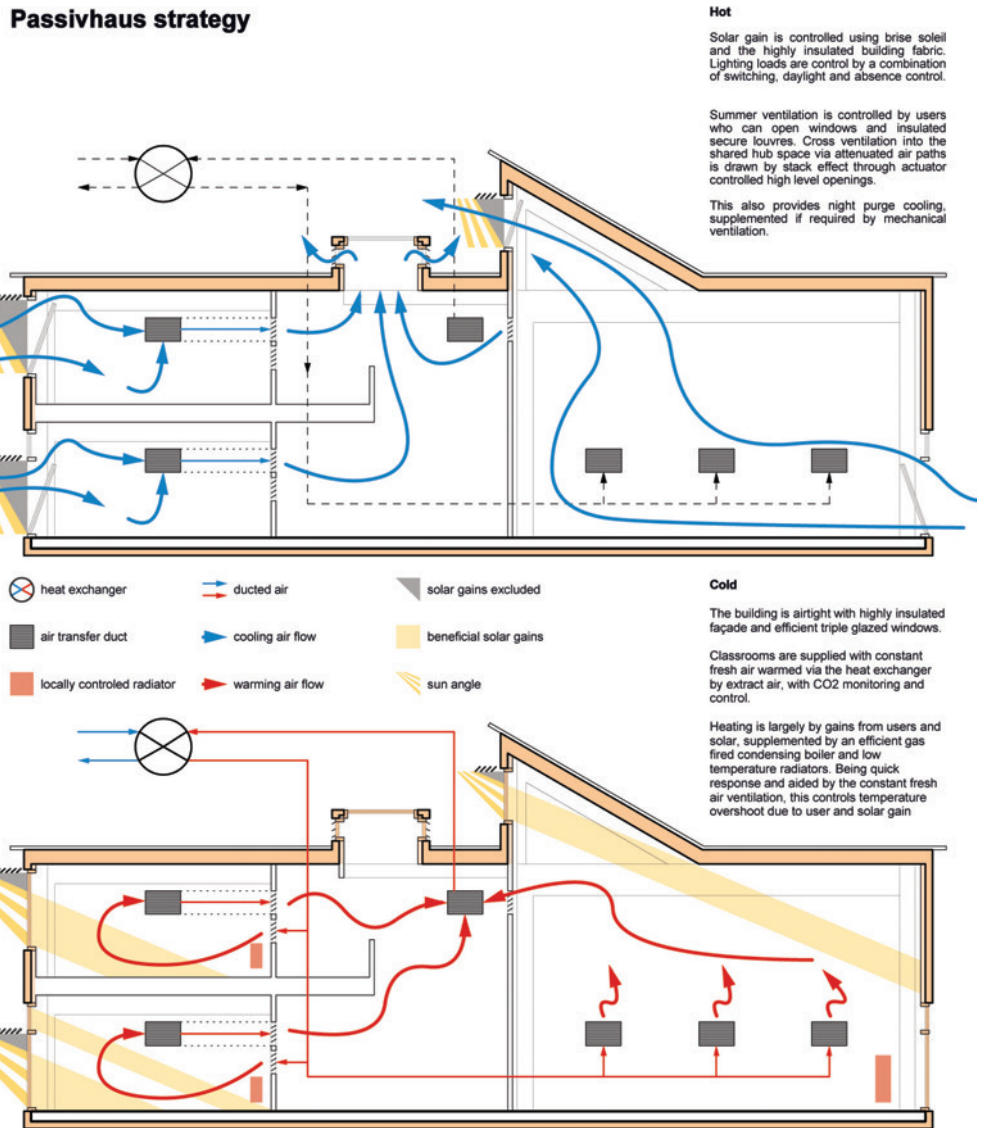
The final airtightness test produced a result of 0.48 air changes per hour — safely inside the passive house standard of 0.6.

Matt Wisdom of Thomas Vale Construction, contractors on the project, says a regimented approach to airtightness ensured the target was met.

This included sending the team to Pro Clima's training facility in Germany and holding on-site airtightness workshops. The site manager's assistant also served as the project's 'airtightness champion'.

Oakmeadow boasts all the other hallmarks of a passive building too, like triple-glazing and heat recovery ventilation. There's also a 65kW Remeha gas boiler if extra heat is needed.

Jonathan Hines says he's "absolutely convinced" that mechanical ventilation is better for passive house schools than natural ventilation — because on cold winter days teachers and pupils don't open windows, meaning classrooms become stuffy and pupils get sleepy. ▶



"We've got a fantastic new school which the children love. They don't doze off in a dingy dark classroom that's too hot"

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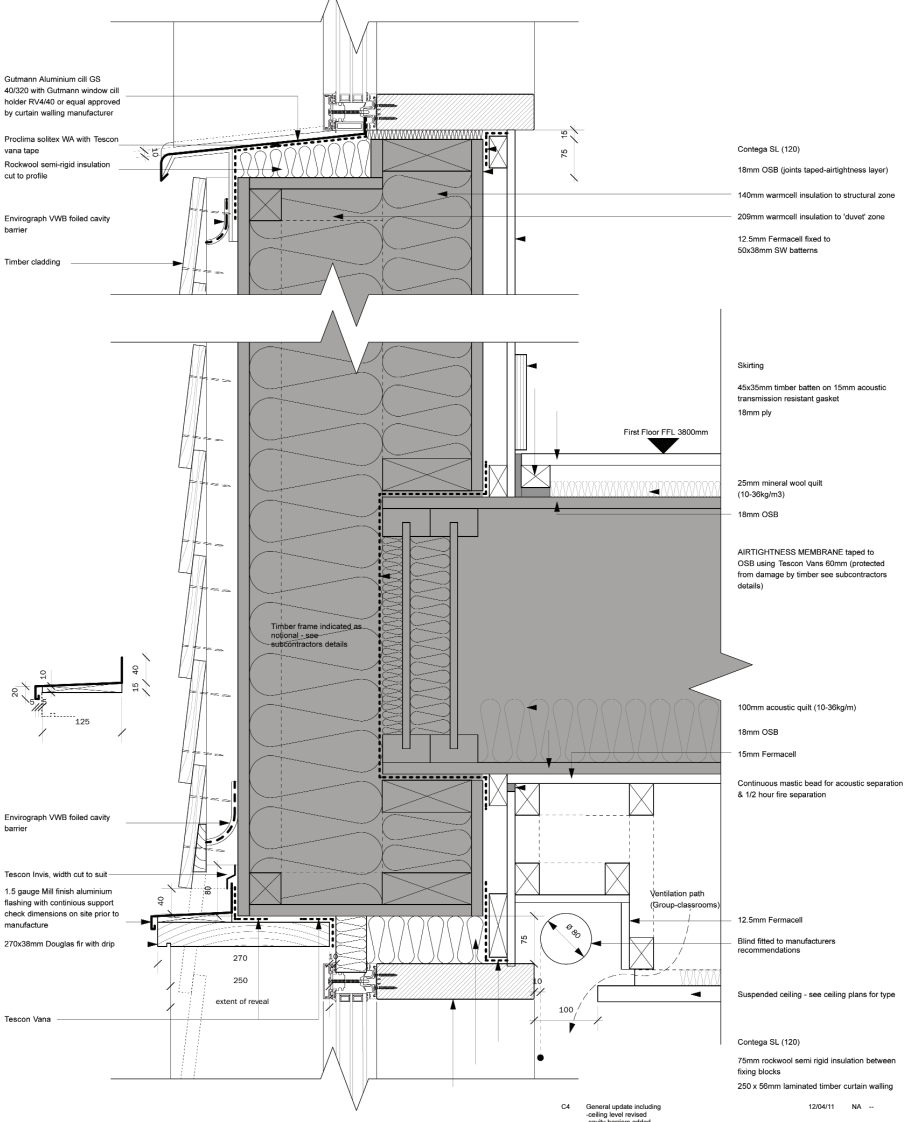

No funding was available for detailed monitoring, but basic performance data suggests the building is using pretty much as much energy for space heating as the designs predicted, and the school used 90% less gas in its first year compared to the old building.

And besides its ultra-low energy consumption, Oakmeadow boasts other green badges of honour. For a start, Thomas Vale say they recycled about 95% of construction waste on site, and the building also features natural linoleum and rubber floors, plus natural paints.

The walls are also lined with Fermacell, a natural board produced with gypsum, cellulose and water — all of it recycled.

Danish-made Troldtekt ceiling tiles, made from 100% natural wood fibres mixed with cement, are used to provide sound absorption in the classrooms and sports hall.

Together with Thomas Vale Construction, the firm is using Oakmeadow and its sister school Bushbury Hill as the basis for a standardised passive house school design that can be easily rolled out on future projects. It hopes this could cut the cost of building a passive house school from £2,069 per square metre to £1,480.

Architype is now working on a new building for Wilkinson Primary School — their third passive house school for Wolverhampton City Council — and some lessons from Oakmeadow are already being applied there.

For example, the firm has designed a bespoke insulated pump house for the sprinkler system rather than use an uninsulated off-the-shelf facility like the one used at Oakmeadow.

The firm is also simplifying lighting controls at Wilkinson — which should help to reduce primary energy demand — and replacing automated windows with manual ones.

At Oakmeadow, Architype went through a detailed consultation with teachers and pupils during the design, and headteacher Sara Morris describes the new school building as "far more purposeful" than the old one.

"The new building is absolutely amazing, it's bright, it's airy," she says. "The temperatures are fairly constant."

There has naturally been a little teething trouble — Sara says mechanical heat recovery ventilation is a very new proposition for maintenance staff — but she's thrilled with the building.

"We have got a fantastic new school which the children love and they're proud of it. They're very comfortable," she says. "They don't doze off in a dingy dark classroom that's too hot."

ARCHITECT'S STATEMENT:
Jonathan Hines, Architype
Over nearly 30 years of practice, Architype has developed a distinctive philosophy that inspires and guides the design of our buildings.

We creatively involve the client and users in an engagingly collaborative design process to create a building that reflects their ethos, as well as meeting their practical requirements.

We seek to be radically ecological – our focus has always been on reducing energy consumption and environmental impact by good design, rather than offsetting carbon with micro-renewables or relying on other techno-fixes or eco-clichés.

We base our design decisions on the evidence and knowledge gained from monitoring our previous buildings in order to improve the performance of future buildings.

We focus on keeping the form and detailing of our buildings elegantly simple, in order to achieve robust design and focus the budget on achieving higher quality and more sustainable buildings.

By combining all of these elements together we deliver highly sustainable buildings that are economically affordable.

Passive house offered Architype a logical progression of our approach to design. It is in effect an evidence-based quality standard that guarantees performance – maximising internal comfort and minimising energy consumption.

We had worked with Wolverhampton City Council since 2006 on a progression of projects, including the award winning St Luke's Primary School – the first BREEAM Excellent primary school in Britain. When we proposed passive house to the council for the design of Oakmeadow Primary School, they enthusiastically endorsed it, being for them a relative small step on from the approach that they had seen succeeding in other Architype projects. However their budget was fixed to that allocated for a normal standard primary school. We faced the proviso that the approach should not affect their tight programme, their fixed standard budget, or the educational brief for the school.

The layout of the building developed from an intensive consultation with the school. Particular design challenges to achieve passive house came in a number of areas.

Form and orientation
We tested and retested ideas, looking at different orientations and options of single and two-storey. It became clear that optimising the ratio of internal floor area to external surface area was critical in minimising heat loss, and we opted for largely two storey forms orientated with all principle rooms facing north or south, to enable maximum useful solar gain with effective control of overheating and good daylighting.

Eliminating thermal bridges
The construction approach is based on previous projects (lightweight well-insulated timber frame), but went a step further. To reduce thermal bridging and achieve passive house airtightness we used a simplified load bearing stud wall (instead of structural I-beam) which is wrapped by an additional 'duvet' layer of insulation created by Larson trusses.

We eliminated all structural penetrations of ▶

the thermal envelope, with roof overhangs and canopies constructed outside of the thermal envelope, and any elements of loadbearing structure contained inside the thermal envelope.

The foundations were rethought completely to create a fully insulated concrete slab, floating on rigid insulation, which returns at the edges to meet the duvet layer in the wall.

Achieving the rigorous airtightness standard
We rigorously worked and reworked every detail, eliminating complex junctions and seeking the most logical, simple and buildable solutions, in order to assist the contractor, Thomas Vale Construction, in achieving passive house airtightness.

We held workshops involving key site staff and subcontractors (timber frame, windows and airtightness tape sub-contractors), to boost everyone's understanding of airtightness and develop a spirit of collaboration. The sequence of work was reprogrammed to achieve a tested airtight shell, prior to proceeding with first and second fix.

The result was compliant and satisfying – 0.48, significantly below the requirement of 0.6, and a 95% improvement on UK building regulations.

Services strategy
The services strategy is developed to integrate centralised full mechanical ventilation with heat recovery (MVHR) for winter operation, combined with natural passive ventilation for summer day ventilation and night cooling. Heating is by means of simple thermostatically controlled radiators supplied by small gas boilers which provide controllable top up heat, although for most of the school day the heat of occupants reclaimed by the MVHR is sufficient to maintain comfortable temperatures.

Windows and doors
Particular attention was given to the design of windows and doors to balance the additional costs of the required 0.8 U-values, and achieve the required daylighting and levels of ventilation. We opted for a curtain walling system with simplified and optimised openings.

Primary energy
In contrast to UK regulations, PHPP takes into account all energy consumption including the unregulated (IT, other equipment and fittings). A key challenge has been addressing the energy consumption of the school's kitchen, as most German schools do not have catering facilities. We opted for electric induction cooking, which is not only more efficient but significantly reduces the need for energy wasteful extract ventilation. The catering staff are delighted with the speed of induction cooking and the increased comfort and lower temperature of their new kitchens.

Conclusion
We're delighted with what we've achieved at Oakmeadow. The layout works effectively for the functioning of the school, the teaching spaces are full of daylight and natural materials, the quality of air delivered by the ventilation system is excellent, and the heating consumption is on target at 15 kWh/m²/yr over the first year of operation – actually 90% less in the first year of operation compared to the old school building.

SELECTED PROJECT DETAILS
Clients: Wolverhampton City Council
Architects: Architype Ltd
Contractor: Thomas Vale Construction
QS: Smith Thomas Consult
Structural engineers: Price & Myers LLP
Services consultants: E3 Consulting Engineers LLP
Airtightness tester: HRS Services
Passive house consultants: Elemental Solutions
Passive house certification: Peter Warm
Timber frame: Cygnum
Windows & doors: Gutmann
Roof lights: Raico
Cellulose insulation: Warmcel, installed by PYC Insulation
Additional insulation: Permarock & Jablite
Airtightness products: Ecological Building Systems
Gypsum fibre boards: Fermacell
Ceiling tiles: Troldekt, supplied by Skanda Acoustics
Heat recovery ventilation: Swegon
Condensing boilers: Remeha

Want to know more?

Click here to view additional information on this project, including an online gallery featuring architectural drawings and photographs.

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PROJECT OVERVIEW:

Building type: 2434 sq m new build 2 form entry primary school with additional multi agency support team area, all of timber frame construction

Location: Oak Meadow Primary School, Wolverhampton

Project budget: £4,977,800

Passive house certification: certified

Space heating demand: 15 kWh/m²/yr

Heat load: 12 W/m²

Primary heating demand: 113 kWh/m²/yr

Energy performance certificate (EPC): B - 35

Heating bills: not provided

Airtightness (at 50 Pascals): 0.48 ACH

Ground floor construction: 250mm high density Jablite insulation (installed in two staggered layers), 300mm power floated slab, floor finish. U-value: 0.064 W/m²K

External wall construction: 12.5mm Fermacell internally, followed outside by 38mm service void, 18mm OSB sealed with Pro Clima tapes, 140mm structural zone, 200mm duvet layer (both above zones fully filled with Warmcel blown recycled insulation), 18mm Bitroc sealed with Pro Clima tapes for airtightness, 50mm cavity, Douglas Fir cladding. Permarock system including DPM, render system and 200mm of EPS 200 insulation at sides of concrete slab U-value: 0.13 W/m²K

Pitched roof construction: ceiling, followed above by ceiling void, 15mm Fermacell (fire lining), 18mm OSB (airtightness, Pro Clima tapes), 400mm I joist fully filled with Warmcel, 9.2mm Panelvent, breather membrane, ventilation zone, 18mm plywood, membrane, aluminium standing seam. U-value: 0.10 W/m²K

Windows: triple-glazed, Gutmann Mira Therm08 passive house certified windows. U-value: 0.9 W/m²K

Doors: triple-glazed, Gutmann S70+ (not passive house certified)

Curtain walls/roof lights: Triple-glazed, Raico - Therm+H-i (Isoblock P gasket) passive house certified

Airtightness: Pro Clima airtightness sealing tapes between 18mm OSB and windows/doors/curtain walls. Pro Clima wind tightness sealing tapes between 18mm Bitroc and windows/doors/curtain walls

Heating system: two Remeha quinta pro 65kw high efficiency condensing gas boilers.

Ventilation: Swegon Gold RX 25 and a Swegon Gold RX 12 AHUs complete with rotary heat exchanger

Green materials: All timber used throughout building within structure and Douglas Fir cladding is untreated (exception: some internal plywood finishes are treated for spread of flame), natural linoleum/rubber floors, Warmcel insulation, Keim mineral paints, Ecos organic paints and OSMO natural paints.

Affordable housing scheme

DELIVERS CERTIFIED PASSIVE RESULTS

Passive house has long been the preserve of early adopters and motivated self-builders. In the last few years however, we're seeing increasing numbers of certificates awarded to commercial buildings and public housing projects. Last year, Hastoe Housing Association and Parsons + Whittley Architects won a UK Passivhaus Trust Award for their Wimbish Housing project, a development of fourteen affordable houses in Essex.

This year, Hastoe and Parsons + Whittley followed up with another fourteen unit affordable passive house development in Ditchingham, Norfolk. Wimbish was a first-time adventure into passive house for both housing association and architects. Building on the experience gained here, the award-winning team set about shattering many of the preconceptions about passive house. Using traditional building materials and skills, they've delivered affordable housing in a conservation area surrounded by listed buildings.

"What we're really about with passive house is this," says architect Chris Parsons. "We try to take the concept and make it deliverable in the UK – make it buildable. We're not at the forefront of developing the methodology. Our strength lies in taking that methodology and painting it onto the UK construction industry."

As any designer, Parsons included, will tell you, one of the keys to making any passive house project work is to build passive principles into it right from the beginning. Despite this, the Ditchingham development wasn't actually intended to be passive. Moreover, the fact that it was located in a conservation area, and adjoins listed buildings – a Tayler & Green development from the 1950s – meant that the design team faced a number of tricky obstacles before ever considering the low energy approach.

As it turned out however, the non-passive constraints actually ended up nudging the architects towards passive. "We couldn't do it as a long, straight terrace," Parsons explains. "We didn't have quite enough land. But that was fine because a curved terrace was a Tayler and Green idiom anyway. Then, in order to make sure that we didn't destroy views of or from the listed properties, that meant that the terrace naturally ended up in one corner of the field with the front of the curve following the sun around. We all looked at it and went, 'That'd be a great passive house scheme.'"

Parsons pitched the idea to Hastoe, and fresh

Although preconceived notions about the existence of a passive house aesthetic still abound, trailblazing projects like the Ditchingham affordable housing scheme in Norfolk show that vernacular architecture & build methods can go hand-in-hand with passive performance.

Words: John Hearne

from the success of the Wimbish development, the housing association agreed to the amended plan.

In line with his aim of using traditional skills, Parsons chose to build the terrace – which is a naturally thermally efficient building form – using a cavity block wall. The 300mm cavity, used in conjunction with specially made wall ties and cavity closers, allows sufficient volume to take enough insulation to deliver a passive standard U-value. Continuing that traditional theme, airtightness is largely achieved using a standard wet plaster finish.

"I've always felt that if we're going to get passive house more widely adopted, we need to demonstrate that you can deliver it in pretty much any idiom," says Parsons. "It doesn't have to look like some contemporary middle European thing. We ►

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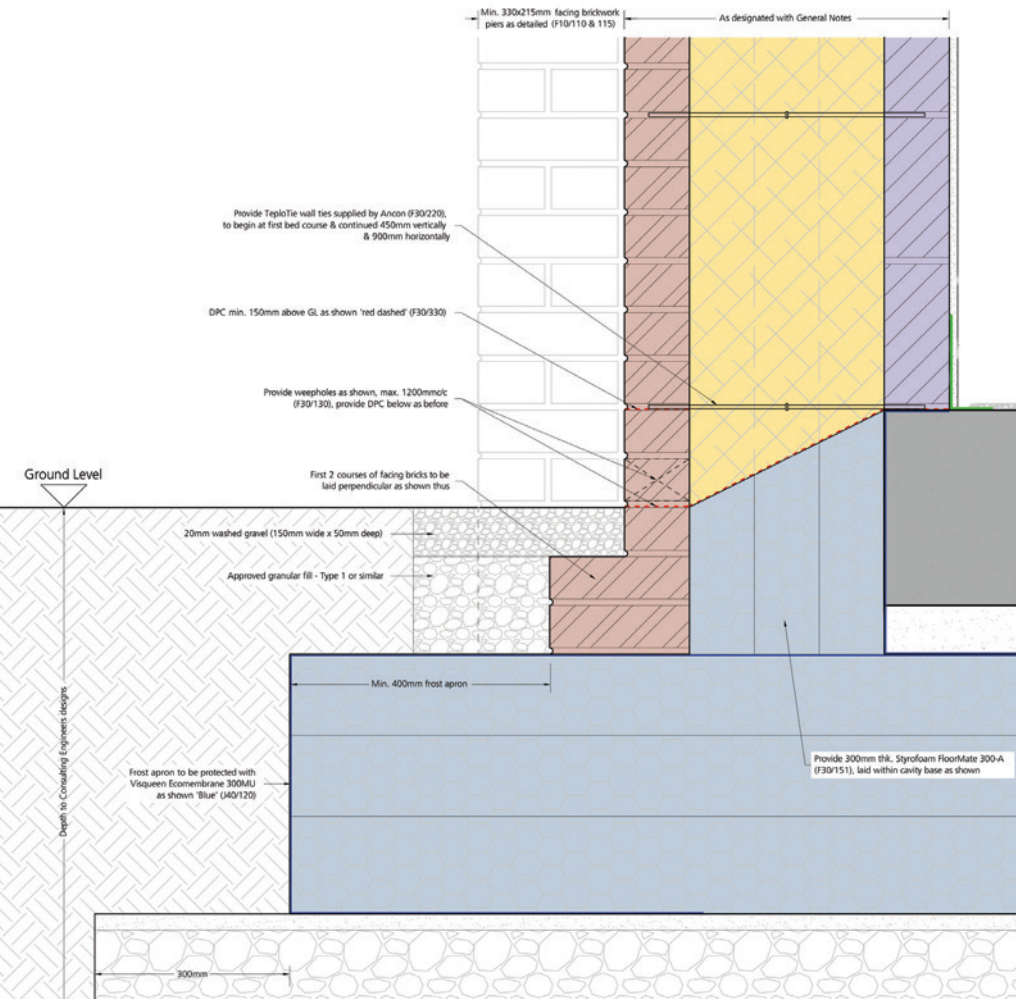

(above) The cavity walls at Ditchingham are fully filled with 300mm of Isover Hi-Cab 32 Glass mineral wool, with 300mm of Styrofoam Floormate laid within the base of the cavity up to DPC level; (p43) the terrace features triple glazed windows from Sidey; Passive House Institute founder Prof Wolfgang Feist's visited Ditchingham in freezing February weather to present the certificate

also really need to deliver it largely using the skill base that's already there. We have to up skill in terms of understanding about airtightness but we don't really want to retrain for new techniques. I think it's important to make it fit the industry rather than the other way round."

The project itself progressed remarkably smoothly. Service consultant James Tickle of ECS Ltd says that the level of discussion and detail that preceded breaking ground meant that unforeseen issues just didn't arise. He says: "Detail is taken to such a level that it leaves very little room for the guys onsite to potentially get things wrong, have to cut corners or do something that's going to have a negative impact." Both Parsons and Tickle emphasise how important it is to have the services consultant present from the very beginning. "You need to have him sitting next to you when you do the pencil sketch," says Parsons.

One issue that doesn't arise with early adopters and self-builders is actual engagement with the passive environment. But when your occupants are completely unfamiliar with the standard, teething issues are unavoidable. "It was a lesson we learned very early on in Wimbish and we tried to carry it through to Ditchingham," says Parsons. "We are providing passive houses to people who don't want a passive house – they want a house."

In order to make the transition as smooth as possible, Hastoe sought early nominations from the local authority so that the project team could engage with the occupants from a very early stage. Information evenings were held where tenants could come and learn what passive house was and how it worked.

"It was quite interesting because the response was 'Oh great we're really looking forward to having comfortable houses with really low energy bills…'" says Parsons. "But we also had a PhD student working with the occupants behind the scenes. He discovered that they were also quite scared because they knew they were getting something that wasn't normal and they were worried that they wouldn't be able to manage or control it."

The design team retained contact with the Wimbish occupants as they settled in, and found that once installed, most householder fears evaporate. "They relax very quickly and very easily because if you design a passive house properly, the passive is the important bit; in other words it should do the job without them having to even understand it."

Particular issues did arise in relation to the mechanical heat recovery ventilation (MVHR) system. Some tenants were turning off their fans at night. Others were adjusting the controls more than they really needed to.

Parsons accepts that introducing people to the whole concept of airtightness often causes confusion. "We've tried to use the term low air leakage," says Parsons. "It's less scary." It's also worth noting that MVHR maintenance and filter management has been retained by the housing association.

"I notice when I do talk to people about passive house, when I introduce the idea of airtightness or talk about low air leakage, I always very quickly move on to talk about the importance of ventilation. I always try to link the two so that they understand that they're still getting fresh air 24/7."

At Wimbish, occupants have actually become competitive with each other about how low their energy bills are. Only six months into occupation in the Ditchingham project, it remains to be seen if a similar virtuous cycle will emerge here.

Brian Carroll of Hastoe Housing Association says that the central motivation for going passive is the reduction of fuel poverty. With two passive projects finished, four more are in train and another five are expected to be launched later this year.

"At the moment, the costs of doing passive house are probably about 12% more than normal build costs." he says, adding that rolling out further passive developments will depend on reducing that premium. He draws attention to the central dilemma of building passive as a housing association. You pay the premium, but the occupants get the benefits.

"We believe that there are health benefits from passive house. The other thing which may happen is that if people have very low fuel bills, they are less likely to get into financial difficulties ▶

"We need to demonstrate that you can deliver passive house in any idiom. It doesn't have to look like some contemporary middle European thing"

and rent arrears won't arise, but it's too early days to know how that will play out."

SELECTED PROJECT DETAILS
Clients: Hastoe Housing Association
Architects/Code for Sustainable Homes assessor: Parsons + Whittley Architects Ltd
Contractor: Keepmoat
Quantity surveyors/employer agents: Davis Langdon
Civil / structural engineer: Richard Jackson Consulting Engineers Ltd
Services consultants: ECS Ltd
Local authority: South Norfolk District Council
Building Control: CNC Building Control
Passive house certification: Kym Mead, BRE
Airtightness tester: LABC
Acoustic consultants/ tester: Noise.co.uk Ltd.
Warranty Provider: LABC
Ecological Designers: Ecology Consultancy Ltd./ ECUS Ltd.
Windows & doors: Sidey Ltd
Airtightness products: Ecological Building Systems
Roofing underlay: Klober
Suspended ceiling system: Gyproc
Insulation: Dow Building Solutions/ Saint Gobain-Isover/ Knauf/ Kingspan
Cavity closers: Cavalok Building Products
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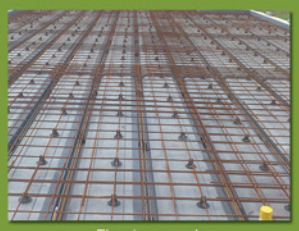
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(above and below) Insulated ductwork for the mechanical heat recovery ventilation system and electrics for lighting are kept inside the airtight layer by a Gyproc MF suspended ceiling system

PROJECT OVERVIEW:

Building type: 1313 sq m curved terrace of houses including 8 two-storey houses, 3 bungalows & 3 flats

Location: Lower Wells Close, Ditchingham, Norfolk

Completion date: July, 2012

Budget: £1,715,517

Passive house certification: certified

Space heating demand (PHPP): 11 kWh/m²/yr

Heat load (PHPP): 9 W/m²

Primary energy demand (PHPP): 108 kWh/m²/yr

Environmental assessment method: Code for Sustainable Homes – level 4 (not yet certified)

Airtightness (at 50 Pascals): 0.6 ACH at 50Pa

Energy performance certificate (EPC): B 88-90

Measured energy consumption: not yet available

Thermal bridging: Due to the passive house design philosophy to achieve a thermal bridge free construction, all thermal bridges were designed out where possible and any known thermal bridges were included in the PHPP calculations with a worst case Y-value of 0.1 W/mK. Window supplier Sidey Ltd undertook all of the thermal modelling to determine all of the Y-values in relation to window & door installation. TeploTie low thermal conductivity cavity wall tie & BigBlok super-insulated cavity closers

Ground floor: 300mm in-situ reinforced concrete raft/slab on 75mm concrete blinding on 400mm Styrofoam Floormate 300-A structural insulation. U-value: 0.089 W/m²K

Walls: facing brickwork, 300mm cavity fully filled with Saint-Gobain Isover HI-Cav 32 glass mineral wool cavity slab, 100mm Lignacite GP block work, finished internally with 13mm 2-coat plaster. U-value: 0.102 W/m²K

Roof: Sandtoft 'Old English' non-interlocking clay pantiles externally on 50x25 battens, followed underneath by Klober Permo Air LR vapour permeable roofing underlay, Timber trusses at 600mm centres with 500mm Knauf Earthwool Loft Roll 40 fibre glass quilt insulation laid between & over ceiling chords, 18mm OSB/3 sheathing, Intello Plus vapour check and airtightness membrane with Gyproc MF suspended ceiling system & plasterboard below. U-value: 0.079 W/m²K

Windows: Sidey SolarthermPlus triple-glazed, PVC-U windows & doors, with argon filling and respective overall U-values for windows and doors of 0.8 and 0.82 W/m²K

Heating & ventilation: Genvex Combi 185 - combined heat recovery, ventilation and domestic hot water unit with certified heat recovery efficiency of 76% with an inline duct heater, plus electric towel radiators in the bathrooms. Three of the dwellings also have 1 sq m Kingspan Marvel 2108 flat plate solar thermal collectors.

Green materials: All concrete and aggregate fill from recycled materials, all timber from PEFC certified sources.

EXTRAORDINARY PERFORMANCE, *ordinary cost*

A new timber frame house in Co Cork, Ireland doesn't just meet the passive house standard, it does so for an impressive price.

Words: Lenny Antonelli

Photos: Alan Spillane

Whenever people discuss the cost of a passive house, they usually debate how much more expensive it will be than conventional build, or how long it will take for the low heating bills to compensate for the extra capital cost.

But this detached passive house in Douglas, Co Cork is different — its designer Deborah Byrne says that, at €109 per square foot, it cost less than a typical Irish home built just to comply with the building regulations.

Byrne, an Irish engineer and passive house designer who has since relocated to Canada, became the project manager for this self-build project when a friend of hers who had initially taken it on decided to return to education. Her clients, James McSweeney and Breffni Noone, had acquired the site from James's parents.

"Having grown-up here, I was really enthusiastic about being able to build a house in Douglas and even more so, being able to build on my family property," James wrote in an email to Passive House Plus. The couple had been saving money to build, and by 2012 they had raised enough funds — and construction costs had reduced sufficiently in the aftermath of Ireland's building boom — that they were ready to get started.

Deborah, who became both designer and project manager, asked James and Breffni to think about upgrading the spec to meet the passive house standard.

"We were not initially thinking of going down the route of building a passive home, mainly because, like so many other self-builders out there, we had thought that a low energy home would be very expensive to build," James says. "However during our first meeting with Deborah, she brought us through the pricing and logistics of a passive home and we were sold. Primarily, we were attracted to the concept of a low energy home by the positive impact on both the environment and our wallet – it seems like a win-win scenario."

But aiming for the passive house standard meant redesigning the house and re-applying for planning permission because, to take one example, the walls would have to be much thicker. This ended up delaying the project by six months.

Deborah went to tender for a contractor, but her clients had a strict budget and she wasn't impressed with the prices. So she decided to act as on-site construction manager herself.

She wanted to build with timber frame but didn't think she'd be able to afford to until the bids came in, and she chose Cork-based timber frame manufacturer Eco Homes, who at the time of writing are on site building a passive house in Surrey.

James and Breffni hadn't considered timber frame initially, but they were impressed with the speed of build it offered, and by the cost too.

"It was apparent as soon as we started discussing the project with [Deborah] that cost and the overall budget were extremely important," says Stephen Spillane of Eco Homes. "It just meant that we had to be very sure of our pricing."

Eco Homes started by laying the Supergrund foundation, which is insulated with 300mm of EPS rigid foam, and built the timber-frame structure in their Carrigaline factory.

The walls are insulated with 235mm of Isocell cellulose insulation, with an extra 50mm of Rockwool in the service cavity. The taped-and-sealed OSB layer serves as the airtight layer, while externally the walls are finished with Limerick-based supplier Greenspan's Aquapanel cement board system — a product with a much lower carbon footprint than concrete blocks.

The roof features 400mm of Isocell with an airtightness membrane, and is finished externally with fibre cement slates. The house's triple-glazed PVC windows are from Munster Joinery, one of the Cork-based manufacturers five certified passive house window ranges.

"The large triple-glazed windows…are great at allowing a lot of radiant heat into the house, but also a lot of natural light," James says.

A four metre square solar collector provides hot water, supplemented by a gas boiler that also provides space heating — though there is no central heating, only a few towel radiators in the bathrooms.

The house's heat recovery ventilation system, a Passive House Institute certified Brink Renovent unit, also has an electric battery to boost the incoming air temperature if it's needed.

The first airtightness test on the house produced a result of 0.27 air changes per hour — more than twice as good as the passive house standard of 0.6. After the first fix of services, the final result dropped to 0.33 — still a formidable achievement.

But while the house meets all the usual tough energy demands of the passive house standard — highly insulated, airtight, thermal bridge free — Deborah believes its crowning achievement is the price.

"For me the exciting part was the cost," she says.

Deborah says the key to keeping the cost down was constantly watching the project spend, and always shopping around. She gives the cedar cladding at the front of the house as an example of how attention to detail and clever thinking helped to reign in the cost.

"Just by agreeing how we cut it we saved 30% on the timber," she says.

The house, interior fit-out and landscaping cost €294,000 — or €109 per square foot. That includes "blinds on the windows, carpets on the floor and beds dressed," Deborah says.

For comparison, she says the calculator on the ▶

(below) The timber frame structure in place, which was built by Eco Homes in their nearby factory; (above) the walls of the house are finished externally with the Aquapanel cement board system which has a much lower carbon footprint than concrete blocks; (P49) the large triple-glazed windows allow a lot of light into the house and, along with the entry door, are all passive house certified

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Rosslare Strand, Co. Wexford, Republic of Ireland

The first of eight Certified Passive Houses located at Grange Lough in Rosslare Strand, Co. Wexford, is now for sale at the reduced figure of €358,000, and offers exceptional value considering that the house comes to market fully furnished.

Rosslare Strand is located in the heart of the Sunny South East Region and being very close to the ferry port of Rosslare harbour and only 2.5hrs from Dublin International Airport, is within easy over-seas access. The house is of 1 and 1/2 storey construction, and is within walking distance of a "blue flag" beach, and the renowned Kelly's Resort Hotel. Golf and other leasure facilities are provided close by.

With a generous floor area of 168m², the house has three bedrooms, two of which have their own ensuites, and a study cum fourth bedroom if required. Fully paved and landscaped gardens and external areas are provided throughout, as is an external store. It's location within a scheme of only eight dwellings ensures that the emphisis is fully on privacy and security for the prospective buyer. Because it is a Certified Passive House very low running costs combined with very high comfort levels are guaranteed. This house won the Isover Energy Efficency Award 2011 for being the most energy efficient dwelling constructed in Ireland of that year.

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PERFORMANCE SPECIFICATION

Passive House Standard
Specific Space Heat Demand: 10 kWh(m²a)
Specific Primary Energy Demand: 83 kWh(m²a)
(DHW, Heating, Cooling, Auxillary & Household Electricity)
Air Tightness : 0.50h⁻¹
Passive House Certification criteria achieved

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The house, interior fit-out & landscaping cost €294,000 — or €109 per square foot — including "blinds on the windows, carpets on the floor and beds dressed"

Society of Chartered Surveyors Ireland website estimates the cost of this project at €124 per square foot — though this includes a hypothetical demolition (there was none here) but doesn't include loose furnishings or site works, so it isn't directly comparable. But she says €115 per square foot is a typical figure for conventional build.

James and Breffni are really pleased with the finished house. "Deborah oversaw the complete project and did an excellent job of managing all the contractors and amazingly brought the project in on time and within budget," James says.

He and Breffni both wanted an open plan, but there was a concern this would make it more difficult for the house to retain heat. But he says the temperature is comfortable throughout the house.

"We are still getting used to the house and how it works, but the whole experience of self-building has been very positive for us."

"It feels good to know that it is possible to build a low energy home that actually has equal or greater comfort levels than conventional homes and with comparable or lower building costs."

"We would strongly encourage any would-be self-builders out there to investigate the feasibility of building a passive home – but get yourself a project manager that knows the space – this is key."

SELECTED PROJECT DETAILS
Clients: James McSweeney & Breffni Noone
Architecture, Civil / structural engineer & services consultants: DBEP
Airtightness tester & products: Greenbuildstore.ie
Timber frame: Eco Homes
Windows & doors: Munster Joinery
Solar thermal & plumbing: Trevor Hill & Co
Heat recovery ventilation: Brink, supplied by Eco Homes
Cellulose insulation: Isocell, installed by Eco Homes
Foundations: Supergrund, by Kingspan Aerobord
Cement fibre cladding system: Greenspan
Entry door: Sturm
Electrics: Robbie Ormond

PROJECT OVERVIEW:

Building type: 257.7 sq m detached two-storey timber frame house

Location: Douglas, Co Cork, Ireland

Completion date: June 2012

Budget: €294,000 for building and interior fit-out including Vat. €340,000 if you include including capital contributions and soft costs such as design, legal, consultation and professional fees

Passive house certification: pending

Space heating demand (PHPP): 12 kWh/m²/yr

Heat load (PHPP): 9 W/m²

Primary energy demand (PHPP): 76 kWh/m²/yr

Airtightness
1st test (after completion of Eco Homes airtightness works): 0.27 ACH / 0.29 m³/m²/hr
2nd test (on completion of first fix services): 0.33 ACH / 0.35 m³/m²/hr
3rd test (on final completion): 0.33 ACH / 0.35 m³/m²/hr

Energy performance coefficient (EPC): 0.411

Carbon performance coefficient (CPC): 0.38

BER: A3 (58.7 kWh/m²/yr)

Thermal bridging: Supergrund foundation with 200mm wide ring beam giving thermal bridge free floor perimeter. Service cavity battens run horizontally and 50mm Rockwool Flexi installed in between breaking the slight thermal bridge of the studs. Windows set back behind wood fibre board of walls in line with cellulose insulation.

Ground floor: Supergrund foundation with 300mm EPS insulation. U-value 0.10 W/m²K

Walls: Eco Homes timber frame wall with rendered Aquapanel cement board on a battened ventilated cavity, breather membrane, 22mm wood fibre board, 235 mm Isocell cellulose-filled timber stud, 15mm taped and sealed OSB, 50mm service cavity insulated with Rockwool Flexi insulation, and 12.5mm plaster board internally. U-value: 0.14 W/m²K

Roof: Tegral fibre cement slates or PVC flat roof membrane externally on 50x35 battens and counter battens, followed underneath by breathable roofing underlay, 400mm of cellulose insulation at ceiling level with airtightness membrane and cross battens with plasterboard ceiling. U-value: 0.10 W/m²K

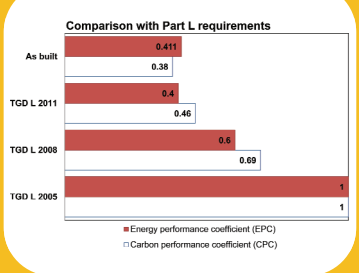
Windows: Munster Joinery passive house certified Passiv PVC windows. U-value: 0.75 W/m²K

Entry door: passive house certified Sturm Top Clima Plus with glazing. U-value: 0.76 W/m²K

Heating system: four sq m solar collector, approx 300l cylinder, gas boiler, gas stove. No radiators or underfloor heating, just towel rads to bathrooms and electric heater battery on MVHR

Ventilation: Brink Renovent Excellent passive house certified to 84% efficiency and 0.29 Wh/m³ fan power. Brink 1kW electric heater battery to supply air with all secondary ducting to supply rooms insulated.

Green materials: timber frame with cellulose insulation, wood fibre board, cedar cladding



3 generations
2 semi-ds
1 passive house

Photos: Alan Smyth

Built on a tricky site in the seaside town of Salthill, Co Galway, Ireland's first semi-detached passive house development is designed to meet the needs of three generations from the same family.

Words: John Hearne

Constructing the country's first semi-detached passive house at a tightly restricted site in Salthill, Co Galway asked a lot of tricky questions of contractor Passive House Builders. Meeting each of these challenges in turn has delivered a passive certified building which is warm, comfortable and above all, cheap to run.

Cyril Mannion of Passive House Builders says that the decision to go passive didn't come until after planning permission had been granted. When he came on board early in 2010, the first job involved sitting down with mother and daughter clients Michele and Karina Heaslip – an interior designer and architectural technologist who run design firm Home Space Planner – and methodically working through the plan to see how it might be adapted to the more exacting demands of passive house.

"The client had already optimised orientation, layout and glazing; positioning small windows to the front-facing north/east and large expanses of glass to the rear-facing south/west," says Cyril. There were however a large number of roof lights, sliding doors and junctions. Passive building tends to favour simplicity of design. In Salthill, a more complex plan required very close attention to detailing – especially when it came to airtightness.

Before that bridge was crossed however, Cyril Mannion had other issues to deal with. An existing structure on the site – the home of Michele's mother Jacqueline Heaton – first had to be demolished to provide the space to accommodate grandmother, mother and daughter. "During the demolition, we segregated the material and took everything – right down to the foundations – away in skips," he says. Once building began, access on either side of the house was reduced to no more than a metre. For that reason, several jobs normally left to the end of the build had to be brought forward. "All of the topsoil and rocks for rockeries went in first, as did the tank for the rainwater harvesting system."

The owners wanted the two semi-detached houses to follow the contours of the site, and that meant a stepped foundation. The solution was a high-density EPS foundation from Kore which delivers all of the structural strength required without thermal bridging issues. The building itself was then built using conventional concrete blocks, which were then externally insulated using 250mm of EPS and finished with an acrylic render, giving it the appearance of a conventional cement plaster finish.

Achieving the passive standard airtightness threshold of 0.6 air changes per hour was quite a challenge, says Mannion. "Between both houses, there were more than 35 panes of glass, three sets of sliding doors and six rooflights, as well as numerous wall, ceiling and floor junctions, all of which had to be sealed." Installing the airtightness layer, using membrane, tapes and plaster, meant that all following trades had to be closely policed to ensure no accidental penetrations wrecked that vital passive house result. "We had an airtightness foreman onsite at all times, making sure that the airtightness barrier remained undamaged," he says.

The roof lights specified were Fakro U5 triple glazed units, with a centre pane U-value of 0.5, and an overall U-value of 0.94. According to Ray Clarke of Irish Fakro distributor Tradecraft, the U5 is not specifically designed for passive house, but is a "solid, low energy product" and has been used on other passive house buildings such as the Department of Education's passive schools in Moynalty and Powerscourt. "Our low energy range includes roof lights specifically designed for passive houses, such as our U6 and U8 glazed units and the FTT thermally broken frame system," he says.

Designed ventilation goes hand in hand with ▶

passive house. Passive house certified mechanical heat recovery ventilation (MVHR) systems were installed in each house. Along with all of the building's mechanical and electrical services, the MVHR units and ductwork were placed inside the building envelope, thereby avoiding unnecessary penetrations of the airtight layer and preventing heat loss – both from pipes or ducts and from leakage through the airtight layer – into unoccupied spaces.

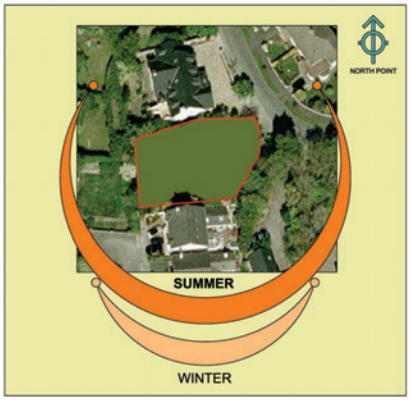
Karina and Michele applied their design skills to keep the services out of sight, hidden by everything from shelving units to ceiling shapes, and installed a redundant fireplace – albeit bricked-up, and connected to no chimney – to provide a visual focal point.

The original budget included the use of condensing oil boilers as a back up heat source, but once again, site restrictions meant that these plans had to be amended. Heat comes via an air-to-water heat pump on House A while the condensing oil boiler was possible on House B. In addition, a favourable orientation on House B facilitated the installation of solar thermal panels to bolster domestic hot water.

"The house is comfortable and draught free," says Michele Heaslip. "It generally holds a temperature of 21C without turning on the heat, particularly on sunny days. However, as I like it at 23C when relaxing at night, I do have to set the controls to suit." She believes too that in an Irish climate, you can't do without a heating system, even in a passive building. "I would strongly argue that an efficient heating system is necessary, particularly as one grows older and less active." Her point is well made: at 90 years old, Michele's mother Jacqueline must be amongst the oldest passive house residents in Ireland, along with some of the more senior residents of the passive certified extension to Glenashling Nursing Home in Kildare. ▶

> "I would strongly argue that an efficient heating system is necessary, particularly as one grows older and less active"

(clockwise from below) The house was designed to track the sun, with large glazed expanses to the south west facing rear of the property; (p50, clockwise from top) the north east facing front of the building; client Jacqueline Heaton; a mock fireplace was installed to create a visual focal point



SUN PATH IN SUMMER AND WINTER
SITE OUTLINED IN RED

Michele likes the fact that the MVHR keeps fresh air circulating and removes stale smells from the house without having to open windows.

Passive house has enabled the family to achieve high comfort levels without paying a premium in terms of energy and environmental costs.

"The electricity bills have averaged out at about €120 a month, which is quite good considering that we have no other utility bills and we do a lot of laundry and cooking, and we have a home office," says Michele. "It certainly compares well with the last house we were in which needed a fill of oil every month during the winter months on top of the electric consumption."

"With the solar panels we don't need to worry about hot water for six months of the year and as we have a water harvester we should never have to concern ourselves regarding water rates."

SELECTED PROJECT DETAILS
Clients: Michele Heaslip & Jacqueline Heaton
Architects: Home Space Planner
Contractor: Passive House Builders
Civil / structural engineer & insulated foundations design: Fore Enterprises ltd
Airtightness tester: Energy Matters
Cellulose insulation: Warmcel, installed by Ecowise
Insulated foundations: KORE
Windows & doors: Optiwin
Roof lights: Fakro
Airtightness products: Ecological Building Systems
Building blocks: Quinn Lite
External insulation system: Atlas, installed by Passive House Builders
Solar thermal: Joule
Heat recovery ventilation: Pure Renewable Energy
Lower level cladding: Tegral Building Products
Rainwater harvesting: JFC ▶

"We had an airtightness foreman onsite at all times, making sure that the air-tightness barrier remained undamaged"

PROJECT OVERVIEW:

Building type: 345 sq m building broken up as two interconnecting units, certified as one house. House A: 214 sq m. House B:131 sq m

Location: Salthill, Co Galway, Ireland

Completion date: July 2011

Budget: not disclosed

Passive house certification: certified as one building

Space heating demand (PHPP): 20 kWh/m²/yr

Heat load (PHPP): 10 W/m²

Primary energy demand (PHPP): 74 kwh/m²/yr

Airtightness (at 50 Pascals): 0.6 air changes per hour

Thermal bridging: cold bridging designed out by use of Quinn Lite blocks and continuous insulation layer

Ground floor: insulated foundation system using high density EPS from Kore, combining an EPS 300 ringbeam, and 300mm of EPS 100 in the floor area. Overall U-value: 0.12 W/m²K

Walls: single leaf Quinn Lite blocks with 250mm platinum EPS external insulation system. Overall U-value: 0.1 W/m²K

Roof: 13mm plasterboard, 44mm uninsulated service cavity, 225mm joists at 600 centres with 500mm loose fill Warmcel cellulose insulation. U-value: 0.1 W/m²K

Windows: Optiwin triple-glazed aluminium-clad larch windows, recessed in exterior insulation to eliminate thermal bridging. U-value: 0.85 W/m²K

Entrance doors: Optiwin Comfort wooden front door. U-value: 0.84 W/m²K

Roof lights: 6 triple-glazed Fakro U5 roof lights. U-value 0.94 Wm²K

Heating system

House A: Stiebel Eltron Compact air to water heat pump supplying underfloor heating and 300 litre buffer tank plus Joule Solar hot water systems supplying 300 litre hot water tank.

House B: Grant Vortex outdoor condensing oil boiler supplying underfloor heating and Joule Solar hot water systems supplying 200 litre hot water tank

Ventilation: Passive House Institute certified MVHR units for each house. House A: 92% efficient Paul Novus 300. Unit B: 90% efficient Paul Focus 200

Water: a Graf 6500L rainwater harvesting system provides non-potable water

Green materials: cellulose insulation, water based paints, all timber from FSC certified sources, 55% GGBS cement, LED lighting

(clockwise from top) one of the two Optiwin Comfort wooden entry doors; a 6500L Graf rainwater harvesting tank is buried in the garden; large expanses of EPS were used to insulate the foundations and walls

Victorian

passive upgrade

pushes retrofit boundaries

Photos: Octavia / Paul Davis & Partners

Turning an old Victorian home into a passive house is a painstaking job that would frighten many building professionals. But the team behind this innovative retrofit didn't just end up with a certified passive house, they got one of the lowest energy dwellings in the UK.

Words: Lenny Antonelli

Building a new passive house is one thing, but getting a run-down Victorian home to meet the onerous low energy standard is something else entirely. Yet that's just what this ambitious and experimental retrofit in Notting Hill, London achieved.

Research just published in the journal Energy & Buildings found the house consumes 62.5 kWh/m^2/yr — less than any other monitored home in the UK, according to the paper's author, Dr Ian Ridley.

Princedale Road project manager Edward Borgstein says a similar project at Lena Gardens, Hammersmith — another passive house retrofit to an historic building — consumes about half that, though it wasn't included in Ridley's paper.

But regardless, this is a bold and experimental retrofit. Even Passive House Institute founder Prof Wolfgang Feist has called it one of the most advanced projects built to the standard.

Bringing old buildings up to the passive house standard is a tricky business — the targets for airtightness and thermal bridging are often too demanding. That's why the Passive House Institute has developed Enerphit, its less onerous standard for retrofit.

But Enerphit didn't exist when work started on 100 Princedale Road, so the team had a simple choice: full passive house certification or nothing. Architects and engineers who upgrade historic buildings often take a gentle approach to cutting energy use, but in this case they did the exact opposite.

"We went all out to fulfil the passive house spec without compromising," says Phillip Proffit of Princedale Homes, the main contractor on the project.

The team also included architects Paul Davis & Partners and energy consultants Green Tomato Energy.

The property is owned by Octavia Housing, a not-for-profit housing agency that says it was founded on the principles of "good housing and mixed communities". Its founder Octavia Hill was a Victorian social reformer who campaigned for better housing for the poor, and for clean air in London.

The project was also awarded £150,000 by Retrofit for the Future, a competition run by the Technology Strategy Board to support innovative upgrades to social housing.

The moisture challenge

Like any retrofit, the first step here was to insulate the house. But being a protected structure in an architectural conservation area, external ►

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(above) The team designed a triple-glazed, airtight imitation sash window with a fixed top pane and tilt-and-turn lower pane, along with custom made triple-glazed doors

(p58) the Bakali family outside their new home. Note the wall-mounted letterbox designed to avoid thermal breaks and infiltration

(p59) 100 Princedale Road's façade reveals nothing of its innovation

insulation wasn't an option.

"There was no way anything that changed the external appearance of the house would be allowed," says Edward Borgstein.

His approach to renovating this 150 year old building was to ask: how can we future proof it for another 150 years?

Virtually all passive house retrofits to date have employed external insulation, but the team was forced to break new ground here by insulating the single-layer brick walls internally. They installed 150mm and 50mm layers of vapour impermeable Kingspan Thermawall TW55 PIR insulation with OSB board sandwiched in between.

Insulating internally is tricky — if it's done incorrectly it can lead to condensation and mould. While it keeps more heat inside the house it also cools down the external wall, creating a 'dew point' where water vapour can condense to liquid between the new insulation and the old wall.

This makes it even more important that the building is airtight, properly ventilated, and designed with a strategy to deal with any moisture that does accumulate.

"When you're working with internal insulation, you have to think a lot about moisture, especially in old buildings," says Borgstein, a Cambridge-educated building physics engineer. "You have to think about how moisture will migrate through the wall, where moisture will be generated." To make things worse the building's old brick is vapour permeable.

The team installed vapour barriers in the walls and put a small air gap between the insulation and the wall — any moisture that condenses here can trickle down and drain out. "That's important as a second line of defence," Borgstein says.

Passive house certifier Peter Warm points out that because the building is an experimental project, its passive house certification was granted on the basis that moisture levels behind the insulation be monitored for two years after completion.

"The certification was dependent on doing the monitoring," he says, a decision which was taken after discussions with Wolfgang Feist. "The point is that we can look at it in a year or two's time and see what's happening." Monitoring began late last year, and will continue till the end of next year to see how moisture levels change over two full heating seasons.

Re-engineering the floors

Renovating to the passive house standard required the team to rethink all the house's floors too. Previously the joists hung in the external walls, but this wouldn't work in a passive house — it would create a big thermal bridge between the inside and outside, cutting through the insulation. The temperature change here would create a dew point that could lead to condensation and rotting timber.

So instead they hung the joists in pockets insulated with Foamglas Perinsul (a thermally insulating block made from recycled glass) on steel beams in the party walls. This means the internal insulation can wrap unbroken around the inside of the house. "The other reason we could certify Princedale is because there were no joist ends," says Peter Warm.

The team also insulated the party walls with 50mm of Kingspan Thermawall insulation to ensure there's some thermal protection should the neighbouring properties ever be left unoccupied and cold.

Taped and sealed OSB board serves as the main airtightness layer for both the walls and roof, which is insulated with both Kingspan Kooltherm and Therma insulation products.

Innovative windows

The passive house standard threw down another big challenge for this Victorian building: how to find a traditional looking window that could meet the requirement for airtight triple-glazing? Typical sash windows with movable sliding panels are notoriously difficult to make airtight, and triple-glazing is usually too heavy to slide.

The solution? The team designed a new window from scratch. The new unit perfectly resembles a traditional sliding sash window, but has a fixed top pane and a tilt-and-turn lower pane.

Edward Borgstein says the team went through a "huge product design process" to develop the window, which is completely airtight.

"It's a solution we are trying to commercialise now," he says. "And it's not much more expensive than a high performance double-glazed unit."

The team took other innovative steps to ensure airtightness too, such as putting the letterbox on the outside wall so it wouldn't pierce the airtight layer or insulation.

Minimalist heating

The essence of a passive house is that it needs little heat to stay comfortable, and Princedale Road is no exception.

The house is heated by a heat recovery ventilation system which uses heat from stale, outgoing air to heat fresh, incoming air. The unit also has a built-in 600w exhaust air heat pump that can recover further heat from outgoing air if needed. Together with a solar thermal system, this provides the house's hot water too.

But before fresh air enters the ventilation system, it passes through a thermal labyrinth in the basement – a network of channels built into the thermally massive floor. Because ground temperature is a fairly constant 12C all year round, it can be used as a ground-to-air heat exchanger to boost the temperature of incoming air in winter, or cool it down in summer.

The team reconfigured the house's layout too: they raised the ground floor to create a more spacious basement, which now serves as the kitchen, and removed the building's chimney to make the house more airtight and gain extra space.

End result

Being an experimental retrofit — Edward Borgstein describes 100 Princedale Road as an "R&D project" — the team are studying it closely, monitoring everything from energy and water use to air quality, as well as the moisture content in the walls.

The early results are promising: energy bills are down more than 60% in the first year of occupancy, CO_2 emissions down 70%, indoor temperatures are healthy all year round, and indoor humidity is normal. There's been a little overheating in the top-floor bedroom, but it's within the passive house standard's allowed limits. ▶

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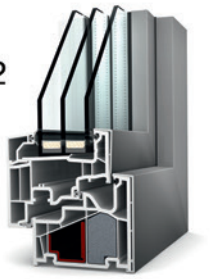

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Perhaps unsurprisingly for such an experimental approach, the project wasn't cheap — it cost £178,000, and a big chunk of that went on developing the innovative windows.

But Green Tomato Energy is now working with Octavia Housing to apply the project's lessons to a universal retrofit strategy for the association, identifying the best ways to reduce fuel poverty and discomfort in its buildings.

Project architect Marion Baeli of Paul Davis & Partners gives contractor Phillip Proffit huge credit for the project's success: "He has a very creative and curious mind," she says.

While this retrofit may be complex, the essence of the passive house standard is simplicity — insulate the building well, make it airtight, and keep heating systems small and simple. That was no different here.

"What we wanted to do was keep the services super simple but ensure that the envelope was passive house, which is what will future proof the house," Baeli says.

"The message really is keep the fabric simple, keep the services simple, don't try to be too clever about it."

The house is now a home for Octavia tenant Bouchra Bakali and her family. She says living in a passive house is much easier than she expected.

"It's more comfortable than any house I've lived in before — it just feels normal, it feels like home," she says. "I thought it would be nice for a local person from the community to get involved in this type of project and it's sparked a lot of interest already with my friends. It means a brighter future for me and the kids."

SELECTED PROJECT DETAILS
Clients: Octavia Housing
Architect: Paul Davis & Partners
Contractor: Princedale Homes
Passive house consultant: Green Tomato Energy
Energy rating assessment: Eight Associates
Passive house certifier: Peter Warm
Clerk of works: David Kneale
Insulation: Kingspan
Windows & doors: custom made by the team
Airtightness products: Ecological Building Systems
Solar thermal: ESE
MVHR: Genvex ▶

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A Genvex Combi 185 MVHR system provides ventilation, connected to an underground labyrinth; (p63, clockwise from top) tenant Bouchra Bakali adjusting the temperature settings; the joists are isolated from external walls in Perinsul blocks, with gaps left for internal insulation

PROJECT OVERVIEW:

Building type: 87 sq m solid brick Victorian mid-terrace in a conservation area

Location: Notting Hill, London

Budget: £178,290

Passive house certification: certified

Space heating demand

Unrenovated neighbouring property: 148 kWh/m²/yr
100 Princedale Road: 6kWh/m²/yr (estimate)
Heat load: 11 W/m²

Monitored final energy demand

Unrenovated neighbouring property: 366 kWh/m²/yr
100 Princedale Road: 62.5 kWh/m²/yr

Energy bills

Unrenovated neighbouring property: £2,026
100 Princedale Road: £772

Airtightness (at 50 Pascals): 0.3 air changes per hour

External walls: brick, 25mm vented cavity, 150mm Kingspan Thermawall TW55, 12mm OSB board airtight layer, 50 mm Kingspan Thermawall TW55 (services zone),15mm plasterboard finish. U-value: 0.106 W/m²K

Party walls: 25mm Kingspan Thermawall TW55, 12mm OSB timber boards (airtight layer), 25mm Kingspan Thermawall TW55, 12mm plasterboard. U-value: 0.276 W/m²K

Roof : two layers of Kingspan Thermawall TW55 – 130 mm between the rafters, and 50mm inside the 12 mm OSB airtight layer – and plasterboard. U-value: 0.15 W/m²K

Ground (basement) floor: 18mm OSB, 150mm Kingspan Thermafloor TF70 insulation, 18mm OSB, 67mm concrete baffle / void (acting as air ducts), 15mm screed under baffles (1:40 falls towards gutter), 125mm new concrete slab, U-value: 0.116 W/m²K

New triple-glazed windows: Custom made triple-glazed sash look-alike, Pilkington

Glazing U-value: 1.15 6 W/m²K

Doors: custom-made doors with triple-glazing and a layer of Kingspan Kooltherm K12 insulation. Glazed doors U-value: 0.85 Opaque doors U-value: 1.0 6 W/m²K

Heating system

Before: boiler & radiators throughout entire building
After: The air coming into the building is pre-heated by a ground-to-air heat exchanger built in to a labyrinth below the basement floor. This utilises the constant 12C ground temperature. The incoming air then passes through the mechanical ventilation heat recovery and is heated further by the stale, outgoing air. If required, an air-to-air heat pump then takes more energy out of the outgoing air and further heats the incoming air. This eliminates the need for a boiler or any radiators or underfloor heating. ESE Solar thermal system, flat plate, drainback system

Ventilation

Before: no ventilation system. Reliant on infiltration, chimney and opening of windows for air changes.
After: passive house certified Genvex Combi 185 MVHR system

CORK engineering school pilots deep energy upgrade

A recently completed pilot project by Cork Institute of Technology may be a model for bringing untenably inefficient and uncomfortable office buildings up to near zero energy performance levels.

Words: John Hearne

When the Regional Technical College network sprang up around Ireland in the late sixties and early seventies, energy was cheap. Ensuring that the building envelope delivered a high thermal performance was not a priority. As a result, the school of mechanical and process engineering at Cork Institute of Technology has not been a particularly comfortable place in which to work or study.

Designed in 1967 and completed in 1974, the 24,000 sq m building is a modular precast concrete structure, with uninsulated external aggregate panels and single-glazed aluminium windows. CIT architectural researcher Marc O'Riain says that the building doesn't retain any heat in winter. "Everyone wears jackets all the time. You have cleaners mopping the floors, you have all these people milling around inside of it, so you get a lot of moisture in the air that just clings to the windows in the winter time."

Meanwhile, overheating is a major problem in the summer. Extensive over-glazing means that temperatures in excess of 36C are common, even on mild summer days, and glare is an issue.

The refurbishment project did not originate as a low energy pilot, rather as a means of establishing a research space for two school of mechanical and process engineering research entities, Medic and Camms. But when external consultants submitted a specification for a conventional retrofit, engineers within the school identified a greater opportunity and the Net Zero Energy Retrofit 2020 test bed project was born.

As the name suggests, the plan is to deliver a full building retrofit leading to the consumption of zero net energy by 2020 – an ambitious target, given that the EU has set a seemingly less onerous "nearly zero energy" requirement for new public

buildings by 2018 on the recast Energy Performance of Buildings Directive.

Energy consumption will be minimised through fabric upgrades, while any additional energy required will be sourced using renewable technologies. In addition to transforming the comfort and environmental performance of the building, the project will also provide a live, controlled test bed environment for building services researchers within the school. Moreover, it's also envisaged that the fabric improvements piloted in the retrofitted section of the building – which represents less than 1% of the original building footprint – will act as a template for a phased full building retrofit in due course.

In its execution, the project brought engineers within the college together with external experts, as well as local businesses, to create an innovative solution to building fabric issues.

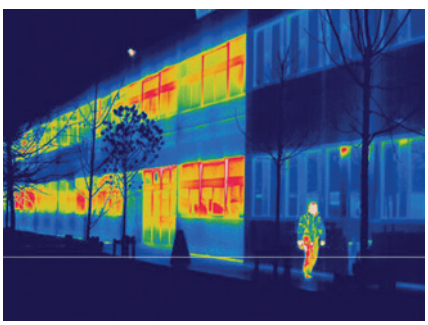
Successful deep retrofits invariably call for a return to 'core and shell'. In Cork however, the institute's building management authority insisted that the design team restrict itself to the removal of non-structural elements. "They felt if they removed the concrete panels and other structural elements," says O'Riain, "that it would cause a lot more cost in terms of re-wiring sill line trunking. Scalability and modularity were important."

Keeping those panels in place meant the design team needed a more innovative approach to remediating the wall build-up.

Turlough Clancy of Dublin-based architectural firm Henry J Lyons was brought on board together with M&E specialists, Arup Consulting Engineers, Kingspan and local manufacturer AMS/Westco Building Products. Working together with CIT's engineers Paul O'Sullivan, Marc O'Riain and department head Daithi Fallon, the team came up with a bespoke curtain wall system which latched onto the existing structure. The new wall system, which incorporates a range of Irish technologies, delivers a passive standard U-value. Moreover, it's a system that is modular and scalable and can easily be rolled out to the rest of the building, and indeed to other similar retrofitted projects around the country. Turlough Clancy at Henry J Lyons says that it is currently under consideration for deployment at two further projects.

"If you think of the prefabricated building stock that was built in the 60s and 70s," says Clancy, "what you have is a tightly defined grid. The precast nature is repetitive. This system literally clamps onto the building and gives you a new skin effectively."

Marc O'Riain says that one of the big challenges that they faced during the build centered on breaking the thermal continuity between the refurbished corner of the building and the remaining, uninsulated structure. "That was a huge problem," he says. A void between the aggregate panels and the internal non-structural block wall runs continuously along the building. "We used an expanding phenolic foam in the cavity to provide us with an insulation and an air break, so we weren't losing exponentially down the void. That solution turned out to be very successful."



O'Riain is also keen to emphasise the importance of using simulation programmes to help arrive at the right building fabric solutions. "We spent a lot of time on simulation," he says. "There is no way of delivering a low energy building without using simulation. Every single detail needs to be focused on and you can't achieve robust solutions without thoroughly investigating each one."

Paul O'Sullivan is a mechanical researcher within the school of mechanical and process engineering in CIT. He says that the team explored a number of different heating solutions before taking the decision to decouple from the existing gas boiler system and replace that with an air source heat pump.

"This was a great opportunity to allocate some of our heating to a renewable source," says O'Sullivan, "which enhances us towards the zero carbon target. It's fully controlled using a Cylon building management system (BMS)."

A mechanical heat recovery ventilation system was ruled out early on in favour of a natural ventilation strategy. This is effectively a combination solution, O'Sullivan explains. At sill level, a double louvred vent can be opened by the occupant to deliver fresh air. In addition, high level vents are controlled by the BMS system, which introduces fresh air depending on inside and outside temperature.

It's early days, says O'Sullivan, who is still calibrating the system to deliver optimal living conditions. "In a passive house, it's easy for the occupants to open the windows to flush the space out. It's a bit trickier if you're in an office with fourteen people. You also have more PCs, lights and so on, so you have a risk there that the heat generated has nowhere to go."

This is an engineer's project to its bones. In addition to the BMS system, the team also installed a data logging system. "It's all wireless." O'Sullivan explains. "We can move the instruments to any location we want for any period…We're collecting a lot of internal temperature data, we've got external surface temperature data, humidity, CO_2…We can use that to inform research and dissemination."

Recognising the value of the research test bed under construction, Kingspan, with whom the research team is sharing the collected data, provided all of the insulation used on the retrofit free of charge.

Now complete, the project – which picked up the design sustainability award at the Institute of Designers in Ireland Awards in November – has transformed a cold, leaky, overglazed building into a well-regulated, comfortable workspace. "The temperature is consistent no matter what the conditions are outside," says Dathai Fallon. "The soundproofing is incredible; it's quite shocking really sometimes when you open the window and realise how insulated from the sound you are."

And as the students and lecturers work, they will also be facilitating the collection of a great deal of valuable data through the data logging system. "The occupiers are, to some extent, guinea pigs," says Fallon. "Their use of the building will help the building services student projects that will be carried out within the centre in the coming years." ▶

Photos: F22 Photography/CIT

Dating from 1974, the original walls and windows have risible U-values of 1.77 and circa 5 W/m²K respectively. The pilot project has reduced the wall U-values of the upgraded section to just 0.11, with windows improved to 1 W/m²K. A thermal image makes the profound efficiency improvement tangible.

SELECTED PROJECT DETAILS
Clients: CIT School of Mechanical & Process Engineering/ Zero 2020 research team
Project architects: Henry J Lyons
Project management: CIT Building & Estates
M&E: Arup Consulting Engineers
CIT team: Paul O'Sullivan, Fergus Delaney, Daithi Fallon, Marc O'Riain
Quantity surveyors: David McGrath & Associates
Main contractor: Summerhill Construction
Insulation: Kingspan
BMS controls: Cylon/Ace Controls
M&E contractor: KP Scanlon
Airtightness consultant: Building Envelope Technologies
Air source heat pump: Dimplex Renewables
Energy meters: Socomec/AEG
Envelope manufacturer: AMS/Wesco Building Products
Windows, doors and roof windows: AMS
Flooring: W2W/Shaw Contract
Ceiling tiles: Ecophon

Want to know more?

Click here to view additional information on this project, including an online gallery featuring illustrations and photographs.

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(above) A cross section of the Kingspan external insulation; due to lack of budget the original roof light wasn't replaced, but the upstand was insulated and airtightened, with a secondary double-glazed unit installed instead

PROJECT OVERVIEW:

Building type: Modular grid optimised precast concrete building designed in 1967, completed in 1974

Area: Complete site: 24,000 sq m. Pilot project: 240 sq m

Location: Cork Institute of Technology, Bishopstown, Co Cork, Ireland

Completion date: September 2012

Budget: €520,000 – including a €250,000 grant from the Department of Education and Science
Passive house certification: uncertifiable

Display Energy Certificate: to be calculated after one year of energy billing. Asset rating calculated using the Non-domestic Energy Assessment Procedure (NEAP) yielded a D3 for the existing building and an A3 for the refurbished section.

Space heating demand
Existing metered thermal energy use: 99 kWh/m^2/yr (based on natural gas metered data).
No metered data available on annual electrical consumption of the local electric oil fired heater located in most offices through the building. A typical day of 8hrs @ average 1kWe power output = 8kWhr per 10m^2 office space @ 30% floor area useable office space = 29,542*0.3*0.8 = 38.4 kWh/m^2/yr unaccounted for.
Calculated annualised thermal energy consumption: < 25 kWh/m^2/yr (estimated)

Environmental assessment method: Preliminary LEED review completed – LEED Silver (desktop study only)

Measured energy consumption: not available yet

Airtightness (at 50 Pascals)
Before: air permeability of 14.77 m^3/hr/m^2 @ 35 Pa
After: air permeability of 1.76 m^3/hr/m^2 @ 50 Pa

Walls
Before: external concrete aggregate panel, well ventilated 80mm semi open cavity, 100mm concrete block inner leaf. U-value: 1.77 W/m^{2}K
After: 125mm Kingspan Kooltherm insulation separated by 35mm well ventilated cavity by a 10mm granite composite panel externally, the existing 65mm aggregated panel, 80mm phenolic foam insulation, 100mm existing inner leaf block. U-value: 0.11 W/m^{2}K

Existing roof: 150mm concrete slab, 25mm degrading polystyrene, 25mm locally failing asphalt. U-value: 0.48W/m^{2}K.

Upgraded roof: features 200mm of Kingspan Kooltherm and 3mm Paratorch PIR foam composite bitumen impregnated Hunton fibreboard. New roof U-value: 0.09W/m^{2}K

Original windows: single glazed milled aluminium framed windows

Replacement windows: AMS Windows with Saint Gobain glass. South & West: triple glazed, argon filled, with additional non glass layer on the internal face with interstitial blinds. G-value: 0.33 (to reduce solar gain due to occupancy loads). Shading coefficient 0.38. Light transmittance 0.71. North: triple glazed, argon filled. G-value: 0.61 (to increase solar gain). Shading coefficient 0.7. Light transmittance 0.62. Overall U-value of 1.03 W/m^{2}K

Roof window
Existing: Coxdome Baselock continous roof light, aluminium frame with Perspex glazing. U-value: 5.7 W/m^{2}K
No budget to replace this roof light, which had a 1.2m up-stand from the internal soffit. Instead insulated flanking sides of the up-stand with 80mm PIR insulated plasterboard & inserted a new double glazed horizontal window in line with inside of soffit, thermally broken, trapping 1m of unventilated cavity. Existing roof light taped for airtightness, with unventilated cavity acting as thermal buffer in winter. Summer overheating mitigated by blinds & ventilation. U-value: 3.68 W/m^{2}K

Heating system: original building served by one low temperature radiator system on a time clock with no temperature control. Heating scheduled from 7AM to 10PM.
The refurbished offices are decoupled from the existing heating system. A new radiator system is installed with thermostatic radiator valves (TRVs) fitted to each rad, fed with low temperature heat from a Glen Dimplex air-to-water heat pump mounted on the roof.

Ventilation: the refurbished offices use a natural ventilation strategy with a combination of manual and automated control of the ventilation openings. Glazing incorporates low level manually adjustable insulated openable door sections with external architectural louvres to provide single sided ventilation. The BMS controls a separate set of high level insulated doors to allow for background ventilation (soon to be controlled based on CO_2 during heating season) controlled using a temperature monitoring strategy in summer months with the aim of promoting night purging of the structure. The glazing ratio (glazed to solid) has been reduced from 1:1.7 to 1:4, significantly reducing solar gain. A daylighting study was completed to support the decision to reduce the glazing ratio.

Green materials: composite compressed granite facade panel with a long lifespan & low maintenance. Existing window frames recycled for carbon offsetting. Shaw carpet with Ecowork backing with high recycled content, no heavy metal dyes, low VOC & recyclable. Irish oak screens for durability and low embodied energy. Ecophon Solo suspended ceiling tiles with a 70% recycled content and fully recyclable.

The cost of building passive

Perhaps the most common argument against making passive house mainstream is that it costs too much to build. But as building regulations tighten and an increasingly competitive passive house sector emerges, does that argument hold water?

Words: Kate de Selincourt

Passive house is often perceived as "very nice – but rather expensive." But is passive house really unaffordable? While some have put the extra cost as high as 15 to 25%, other estimates tend to be lower, with estimates of the 'cost uplift' for building to passive house estimated anywhere from around 12-15%, down to 0% – or even below.[1]

The differential does appear to be slowly diminishing, with a handful of pioneers (for example Beattie Passive with their kit houses, or two of the projects featured in this issue[2]) reporting that they have achieved passive house on the same budget as the standard alternative.

Clearly there can't be one figure for 'how much more does passive house cost?' – it depends what you are comparing it with, for one thing. In Ireland, is it the 2005 version of Part L or the 2008 or 2011 revisions, complete with their respective 40% and 60% energy reduction targets? In the UK, is it 2010 Part L? Level four in the Code for Sustainable Homes? The 2016 zero carbon standard?

The UK Passivhaus Trust do not give a definitive figure for the cost of passive house, as "there is as yet no consistent metric" – though they are commissioning some research.

Costs for delivering a passive house-level retrofit are even harder to derive, as so much depends on the existing building, and there are no obvious standards for comparison.

Nonetheless, for any projects currently considering passive house, design teams will be asking themselves what the costs would be.

Starting with the capital costs (which of course, are not the only ones to consider), advice from those who have built to the passive house standard is:

- Some extra components and materials are required (such as MVHR – though this is becoming more common generally – and more insulation);
- Some components are more expensive (doors and windows, for example).

To set against the extra expense, there are factors that bring the build cost for passive house back down again including, notably, much smaller heating systems. And passive house form is naturally economical, as passive house consultant Nick Grant points out: "Excess envelope area that does not deliver useful floor area means wasted energy ... but also, wasted cost."[7]

Are relative – or even absolute - prices going to come down?

While passive house is relatively unusual, components will be dearer. As demand rises, choices are widening, and prices should fall: the iPHA reports that in Germany "triple-glazing now has more than 50% market penetration, and has dropped in price significantly. The same holds true for ventilation systems." In Ireland, where both the rapid uptake of passive house and a significant increase in the national building regulations have increased demand, mainstream window manufacturer Munster Joinery has begun to produce passive house certified windows at relatively low cost, for example.

Design costs for passive house are often higher as well – but this too may be a reflection of the fact that for many it is a new approach, rather than an inherently more fiddly one. Chris Parsons of Parsons Whittley – who picked up a UK Passivhaus Award in 2012 for their Wimbish social housing scheme – says: "We produced 78 detailed drawings for Wimbish whereas a similar Code 4 scheme had only 17. Of course we were being careful, but communicating the passive house sensitivities properly is part of the battle."

This effect may therefore be temporary: "I am confident that costs are coming down, as designers find more confidence, the product market gets more sophisticated, and as the contractors get less afraid of the risk," Parsons says. "However, in the UK, we are still in the very early stages of the latter."

Convergence from upgrading the mainstream

As building regulations are tightened nationally and internationally,[8] whatever 'premium' there is for passive house naturally narrows. In Ireland, where the performance standards for new buildings have already been dramatically increased, sustainable design consultant Jay Stuart (a leading figure in the lobby for reform, along with this magazine) suggests this means the difference in cost between a standard minimum compliant building and a passive house building is now "negligible".

In the UK, progress is slower, with announcements awaited at time of going to press on both the 2013 Part L changes and the final shape of the 2016 "zero carbon" standard for dwellings.

The UK's Zero Carbon Hub has said that passive house should be counted as satisfying both the 2016 fabric standards and the first layer of 'on-site' carbon reduction in one go – avoiding the need for on-site renewables.[9] This could save money, and boost adoption, which in turn may ease prices for passive house downward again, even as general construction prices are being pushed up by the new standards.

While no-one can offer a costed analysis, it's plausible that prices could reach parity at some point – or even that passive house could turn out to be cheaper, at least for some schemes.

Lifetime costs

Even if construction costs for passive house currently remain higher, at least in some situations, how much does this matter? How does passive house stack up as a 'lifetime buy' for the investors putting up the capital?

Looking at costs this way, there is plenty of evidence that even at 2013 construction and energy prices (and 2013 interest rates) passive house is a very sound investment.

The most obvious lifetime saving is on energy costs, of course. Jay Stuart says he helped convince the Irish housing industry to adopt a very low energy design specification "with just a simple spreadsheet showing that over a 25-year mortgage, upgrading to this standard represented an excellent return on investment – the return on any extra investment is always in excess of 10%." Bere Architects have also calculated that with current interest rates and fuel prices, a passive house presents a more economically viable investment for a prospective home owner.[10]

Although there is a lot of anxiety about the high costs of deep retrofit, the same financial rationale may apply. A study cited by the International Passive House Association found the additional costs for a passive house level renovation were about 8%, while the cost per kWh saved were below €0.06, compared to €0.07+ per kWh for energy.[11]

Not everyone expects to occupy a building they commission for the full lifetime of the finance. Public authorities do – hence the attractiveness of passive house to Irish Rail for its train driver's accommodation building, UCD's Roebuck Castle halls of residence, the Irish Department of Education's passive schools in Meath and Wicklow, Wolverhampton City Council's primary schools, and Powys County Council's Canolfan Hyddgen at Machynlleth.[12]

For private purchasers, 20-30 years of a loan term may be too long a horizon. But there are other cash benefits to passive house that tell even in a shorter spell of ownership.

Not only are warmth, comfort and low energy bills immediately rewarding, but building quality is a worthwhile investment for its own sake, as Chris Parsons points out: "With passive house you are getting a much better quality building. Though of course, accountants famously don't price value, only cost!

"But I argue that there is a reduced maintenance cost, both from the better components, but also because you don't have condensation and moisture issues, which cause tremendous fabric damage to normal dwellings." In other words, for a householder, a nice home that stays nice, lower maintenance costs – and if prospective purchasers in future pay more attention to running costs than they do today, better resale value too?

For a social landlord, who, though not paying energy bills, has a long term interest in the fabric, lower maintenance costs alone can repay the passive house cost premium. Norwich-based Broadland Housing Association has plans to build a large passive house apartment scheme, and have reportedly calculated that although their apartments will be more expensive to build "this can be recouped over 30 years by savings in management costs."[13] Orbit Heart of England Housing Association adds that "Satisfied customers result in reduced management and maintenance costs."[14] ▶

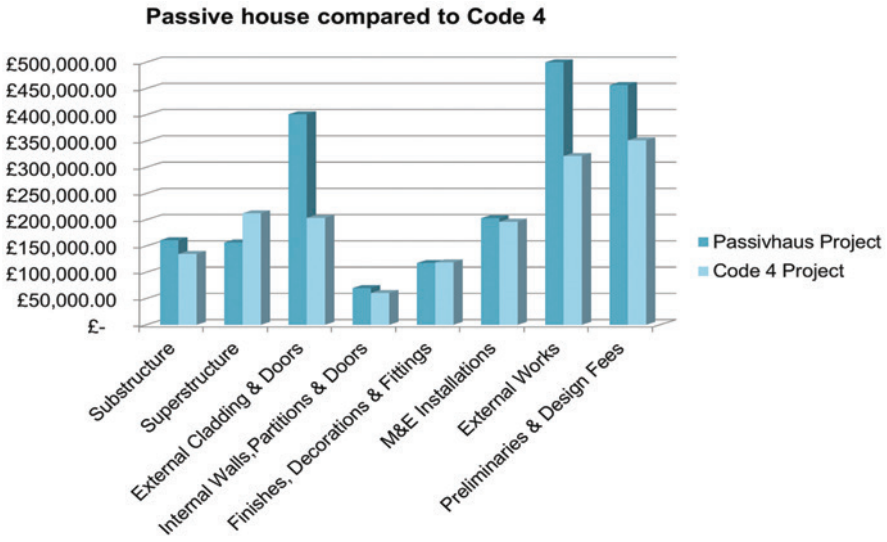
Estimated extra costs for passive house

- **15-9% above UK Part L 2010, Bere architects: small detached passive house prototypes for a housing association;**
- **12 and 6% above Code 4 (on the UK's Code for Sustainable Homes) for Wimbish and Ditchingham schemes respectively: Hastoe Housing Association;**
- **12% above Code 4 for proposed apartments: Broadland Housing Association[3];**
- **3-8% extra above German low-energy standard in 2006: International Passive House Association (iPHA). They suggest this may now be lower[4];**
- **0-7% extra: Neil Cutland, 2010 review of prices over Europe.**

...or no extra cost

- **0% vs existing schools budget: Architype, Wolverhampton primary schools;**
- **0% vs traditional construction to UK Part L 2010: Beattie Passive's standardised timber kit houses[5];**
- **Negative: Jay Stuart, passive house in Ireland using single skin blockwork and external insulation, vs traditional masonry double skin**
- **- 4.5% (predicted) vs BREEAM Very Good: Architype archive building requiring specialist levels of environmental control. Passive house cheaper through significant reduction in plant.[6]**

Estimates of extra cost for passive house range from 12-15% extra down to zero, with some even predicting lower cost for passive house.



A cost analysis of a passive house scheme & comparable scheme built to level 4 on the UK's Code for Sustainable Homes. *Courtesy of Davis Langdon, an AECOM Company*

Whoever is paying for the energy, if it's too expensive, the investor suffers

But in the end, it is simple energy costs that could swing the financial argument for more and more clients, in all sectors.

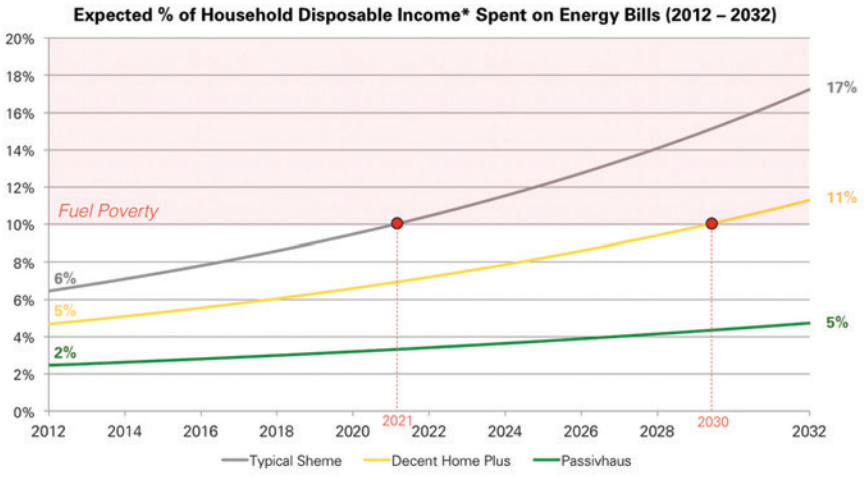
Thus even when housing associations and other landlords do not pay directly for their tenants' energy use, they still benefit from keeping tenants out of fuel poverty. While the primary motivation may be social, there is also a sound financial case to be made: "Rising energy prices create a strong business case for investing in passive house," Broadland Housing Association has said, "as lower fuel bills will mean tenants have more money to pay their rent."

Andrew Savage, executive director for business growth at Broadland Housing Group, believes that more reliable income streams make passive house an attractive financial option for "savvy investors". Has this logic got through to the corporate lenders? Kevin Hartnett, business development director of Hastoe Housing Association, agrees there is a good business case for passive house, but hasn't seen evidence of big lenders taking this on board "as yet".

However, rent arrears and debt to energy companies are already rising.[15] [16] Given the precarious situation so many households are finding themselves in, the decision of some social landlords to protect their tenants from fuel poverty via passive house seems a wise one.

Might this same effect one day become important for investment in private homes – and influence mortgage lending? In the UK owner-occupier finance market, there are already some products offering discounts for borrowing for low energy homes, or for carrying out low energy retrofits.[17] These products have not formally included the "low energy bill/low default risk" into their calculation, though Paul Ellis of the Ecology Building Society (which offers a 1.25% discount on the lowest energy homes, including passive houses)[18] has found that "a low energy building tends to be a higher quality building with lower running costs, which makes it a lower risk for us."

However, a recent report in the Washington Post real estate section offers hard evidence that "savvy" mortgage lenders ought to give running costs more thought when making lending decisions.



When will UK households on twice average income be in fuel poverty (assuming current rate of 8%pa fuel price inflation)? In a typical home with just basic loft lagging: 2021. A 'decent homes' basic upgrade (50mm wall insulation, double glazing & new boiler) puts it off till 2030. Passive house/Enerphit occupants are protected for the foreseeable future. Note Ireland, Scotland, Wales & Northern Ireland would all fare worse than the UK average.
Graphic courtesy of Eight Associates. Passive house data thanks to Paul Davis + Partners/Octavia Housing/Princedale Homes

Earlier this year, the paper reported that in a sample of 71,000 home loans from across the USA, "researchers found that mortgages on homes with Energy Star certifications were, on average, 32 percent less likely to default than were loans on homes with no energy-efficiency improvements."

Researchers took pains to statistically separate out other factors that might account for the striking difference, but concluded that the effect was genuinely related to the energy performance of the homes.[19]

Fuel poverty here we come

Lenders might have to wake up their ideas about the buildings they are lending on, quite quickly. Average domestic energy bills have been increasing at around £100 a year for some time, and show little sign of slowing.[20] Yet if anything, incomes of the most disadvantaged, and probably middle-income households too, are falling.[21]

As numerous experts warn, energy prices are rising over the longer term, and not just because we are investing in low-carbon energy. Fossil energy itself is also becoming more expensive, as demand rises, and sources become more expensive to extract.[22]

How can we realise these opportunities?

So, it does look as if there is an increasingly convincing case that building and refurbishing to passive house levels provides a good return to investors, and an excellent deal for occupants and planet.

One of the best ways to ensure we maximise these benefits nationally might be to legislate for higher standards – both in design and performance – faster. After all, this would start to ease the political pressure on fuel prices and decarbonisation; it would improve health, especially among the disadvantaged and elderly, tackling the human cost of fuel poverty and saving many hundreds of millions of pounds and euro a year in health and welfare spending.[23]

Direct government spending on low energy retrofit can even be profitable, returning more in Vat, income tax receipts and reduced out-of-work benefits than the initial investment;[24]

With a long-term interest in the properties they procure, public sector clients have started investing in passive house, such as the Irish Department of Education's pilot passive schools in Wicklow and (above) Meath and (opposite, l-r) Hastoe Housing Association's Wimbish affordable housing scheme, Irish Rail's Train Drivers' Building, and University College Dublin's Roebuck Castle halls of residence

and if passive house really is more expensive to build, this should translate into more labour and materials – meaning more economic activity.

In fact it's hard to see who would lose, other than, if one wanted to be cynical, those whose business model depends on a degree of shoddiness.

If changes to building regulations are anything to go by, this argument has largely been won in Ireland, yet in the teeth of this logic, the UK government is dragging its feet, suggesting it is hard to increase building standards in case 'too much red tape stifles development'[25] or makes it 'unviable'.

Mark Brinkley, author of The Housebuilders' Bible, argues that any added costs for development simply mean land values would fall – which ought not to be a problem, since the "value" is simply the unearned increase in price generated by development rights. "Developers work out the eventual value for the development, subtract the development costs, and arrive at the price they can pay for the site. So saying adding costs makes development "unviable" is a slightly specious argument."

Jay Stuart believes that there are cultural, even psychological issues at play: "I think the perceived cost of passive house is because of the fear factor. In my experience passive house is not difficult to do, the big thing is dealing with change – people don't like change." Bruce Tofield at the University of East Anglia has also identified entrenched adversarial practices – including pushing risk down the chain to subcontractors – as a major obstacle to the teamwork required to deliver genuine energy efficiency.[26]

Perhaps in the end, it might be the market that offers the best hope of raising standards. Jay Stuart is an optimist: "I would say this is the way you can exceed the market – a house you can show to be extremely warm, comfortable and cheap to run."

This has been the experience in Frankfurt, home of the passive house movement. The International Passive House Conference in April heard that landlord and developer ABG Frankfurt builds to passive house standards because it is commercially successful for them: "Passive house buildings are a profitable product" they report. Strong demand from buyers and tenants means swift sales and no voids, and thus a reliable income stream.[27]

Meanwhile in the UK, RIBA and Ipsos Mori found that among the occupants of new houses who were dissatisfied with their homes, high energy bills were by far the most frequently cited cause of that dissatisfaction.[28] Customers are paying for low standards once a quarter, and may eventually demand better.

Could a combination of rising energy prices, consumer awareness and intelligent finance pull the UK industry forward, faster than they are being half-heartedly nudged from behind by a vacillating and conflicted government? We seem a long way from that point now, but if a virtuous circle of rising awareness, increased demand, and falling prices starts to operate, who knows?

This year's International Passive House Conference also heard how ABG Frankfurt found the admin for billing tenants for heat in their latest passive house apartments cost more than simply supplying the heat for free. So they don't bother to charge. What would Irish and British householders think if they heard about that? Perhaps they should be told.

[1]http://www.homebuilding.co.uk/advice/key-choices/green/Passive House-overhyped
[2]Deborah Byrne's passive house in Cork (p36) and Architype's Oakmeadow school in Wolverhampton (p46)
[3]Based on cost estimate at £1,500 per square metre compared with around £1,350 for a home that meets Code for Sustainable Homes level 4
[4]http://passipedia.passiv.de/passipedia_en/basics/affordability/investing_in_energy_efficiency/are_passive_houses_cost-effective
[5]http://www.building.co.uk/buildings/green-for-growth-zero-carbon-homes/5049330.article
[6]www.ukpassivhausconference.org.uk
[7]http://www.aecb.net/forum/index.php?topic=2529.0
[8]Euractiv http://tinyurl.com/cynuo4h In Europe, the Energy Performance in Buildings Directive will require all new buildings in the EU to be "nearly-zero-emitting" by 2021
[9]Zero Carbon Strategies for Tomorrow's Homes, Zero Carbon hub 2013
[10]Nick Newman, International Passivhaus Conference 2012
[11]http://passipedia.passiv.de/passipedia_en/basics/affordability/investing_in_energy_efficiency/economic_feasibility_of_passive_house_retrofits
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[14]Why Passivhaus, Passivhaus Trust, 2013
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[19]http://articles.washingtonpost.com/2013-03-28/news/38114519_1_utility-bills-energy-star-homes-energy-efficient-homes
[20]http://www.dailymail.co.uk/news/article-2216195/Devastating-power-rises-hit-8million-homes-British-Gas-raise-prices-80-month.html
[21]http://www.resolutionfoundation.org/publications/final-report-commission-livingstandards/ via Bruce Tofield
[22]http://tullettprebonresearch.com/2012/11/23/hot-air/
[23]http://www.energybillrevolution.org/fuel-poverty/
[24]http://www.renovate-europe.eu
[25]Building regulations minister Don Foster said (Building, March 6 2013) that "he was struggling to strike a balance between improving standards and encouraging activity in the house building sector, which is lagging far behind what it needed."
[26]Delivering a Low Energy Building: making quality commonplace, Bruce Tofield, UEA, 2012
[27]17th International Passive House Conference
[28]Housing Standards and Satisfaction, Ipsos Mori and RIBA, 2013

Bridging the building performance gap

Predicted energy usage seldom reflect actual consumption, whether in the case of typical stock or notionally low energy buildings. But how well does passive house turn theory into reality?

Words: Mark Siddall

Over the last number of years research by Leeds Metropolitan University (Leeds Met) has repeatedly shown that new homes, including those built to UK building regulations and the Code for Sustainable Homes are performing much worse than expected. The researchers have consistently measured cases where the heat loss of the homes is 40 to 70% greater than predicted. They've observed that these performance issues arise from failures in the design, procurement and construction of buildings and that as energy performance standards become ever more demanding there is a tendency for this gap to increase. The performance gap is not restricted to the shores of the British Isles. Similar issues have been observed in Germany, Austria and Sweden.

It was concerns about the serious underperformance of supposedly low energy buildings that led Prof Wolfgang Feist to develop the Passivhaus standard (referred to later as 'passive house' at the editor's request). But does the standard perform in practice?

Whilst first researching passive house I also became fascinated by research regarding thermal bypass and the impact that it can have upon the performance of the building fabric. These concerns led to two papers presented at the International Passive House Conference and UK Passivhaus Conference[1]. Awareness of thermal bypass has consistently underscored my approach, and that of a number of others, to the passive house standard.

As project architect and passive house designer for the Racecourse scheme by Gentoo I had the chance to test the theories that I'd learned about. Could I, along with the rest of the team, close the performance gap that has been observed elsewhere?

Leeds Met has recently performed co-heating tests on two of the twenty five passive house residences on the Racecourse Estate. I'm pleased to report that each result has demonstrated a very high level of correlation between the measured and predicted performance; within the accuracy of the test method. Figure one (below) shows results of coheating tests from Leeds Met database, with Racecourse homes on the right.

Is this a freak occurrence, or are similar results being achieved at other passive house developments? As it happens, further co-heating tests – by other organisations and institutions – have recently been conducted on three other passive house dwellings on different sites in the UK. Each has reported similar results. It was on the back of this success that I recently co-authored a paper with John Trinick of Warm and Dr David Johnston of Leeds Met that was presented at this year's International Passive House Conference.

While I'm mindful that this is a rather limited dataset, and therefore can't be considered statistically reliable, it's the best evidence to date that the energy/carbon performance gap can be closed. So what appears to be the secret?

It's pretty a simple answer: dedication. It's about ensuring that appropriate understanding and quality assurance mechanisms are in place throughout the entire supply chain for the duration of the project – from clients to architects and engineers to contractors and sub-trades. So, with my rose-tinted glasses on, it would appear that the passive house standard – when complimented by suitable attention to thermal bypass – has what it takes to deliver building fabric that performs.

This is great news, but does it mean we can relax? Let's step back for a moment and borrow a few words from Dana Meadows, author of Thinking in Systems and co-author of the Limits to Growth:

> "Ideally we would have the mental flexibility to find the appropriate boundary for thinking about each problem. We are rarely that flexible. We get attached to the boundaries our minds happen to be accustomed to.....
>
> .....It is a great art to remember that boundaries are of our own making, and that they can and should be reconsidered for each new discussion, problem, or purpose. It's a challenge to stay creative enough to drop the boundaries that worked for the last problem and to find the most appropriate set of boundaries for the next question. It's also a necessity, if problems are to be solved well."

Even if we can replicate the apparent success of projects like the Racecourse homes, we still have a long way to go before closing the performance gap. Why? Because so far I've left out the people who use and occupy the buildings! Buildings are what economists call experience goods; the characteristics, such as quality or price, are hard to appreciate until they're used, experienced or "consumed." In my view the passive house standard succeeds because it addresses qualitative issues that directly relate to the end user – the ultimate consumer. Thermal and acoustic comfort and minimised energy bills would be typical examples of value, as may be the satisfaction of knowing that the carbon emissions from the home are being minimised.

With regard to comfort, it's worth noting that the passive house standard is resilient to "comfort take." The CEPHEUS study recorded indoor temperatures for more than 100 passive house homes;

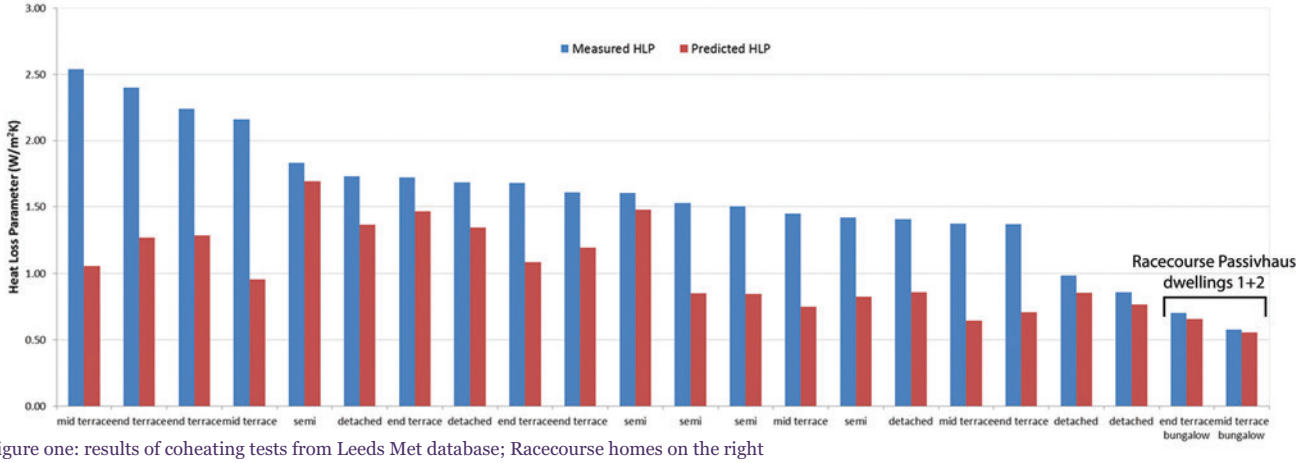

Figure one: results of coheating tests from Leeds Met database; Racecourse homes on the right

the lower range of average household indoor winter temperatures was 17C whilst the upper average was closer to 25C. The mean indoor temperature selected by households was 21.4C; some 1.4C higher than the assumed design temperature of 20C used by the passive house design standard. The resulting increase in energy demand doesn't appear to destabilise the passive house standard itself.

For instance, figure two shows that the measured space heating energy demand in some homes is three times greater than the design target – the energy demand is nearer to 45 than 15 kWh/m²/yr. Does this mean that the standard fails to deliver the stated energy performance? If we analyse the dataset more closely we find that the mean energy demand for space heating is 16.95 kWh/m²/yr.

It's important to recognise that the energy demand for the homes represented in figure two was recorded primarily within the first year of use – when the buildings were still drying out. This process has been found to increase the energy demand by about 1.5 kWh/m²/yr compared to future years. If we correct for this drying out, we find that the adjusted median energy demand for space heating can be said to be about 15 kWh/m²/yr. However even an additional 5 kWh/m²/yr equates to only £0.24/m² (based upon natural gas at £0.048/kWh). We must also remember limits to the accuracy of measurement. In the past Prof Feist has confirmed that it isn't economical to deliver greater accuracy absolute than the range of +/-3 kWh/m²/yr; so it's reasonable to expect that some latitude, one way or another, may be expected.

So how does the passive house standard deliver such resilience against the variable demands of the end user? First and foremost the Passive House Planning Package, the core design tool for passive house design, is built upon a robust set of assumptions that have been tested and verified through monitored building performance. Compared to dynamic analysis tools PHPP is relatively simple, thereby reducing design risk by requiring less data input. It's further simplified by relying upon a number of design parameters such as the use of external dimensions. This simple change in geometric accounting procedure means that thermal bridging calculations may be avoided provided that the continuity of the insulation is suitably maintained. This saves both time and expense whilst also creating design tolerance due to the tendency for external dimensions to overestimate heat losses.

The high standards of airtightness required by the passive house standard are beneficial in several ways. Firstly, drafts are minimised to such an extent that, for the same standard of comfort, the temperature of a room may be reduced. Secondly, airtightness helps to ensure that the balanced ventilation system performs its function with near optimal effectiveness, which serves to ensure that excellent indoor air quality may be achieved. Also a tight building with controlled ventilation has a more predictable energy use than a draughty one with random window ventilation – another factor in closing the gap between theory and practice.

The use of heat recovery is a sensible addition to the provision of a balanced ventilation system. This not only serves to minimise energy demand and carbon emissions but also, and perhaps most crucially, helps to maintain draught free thermal comfort – even in the depths of the winter. The acoustic standards required by the passive house standard also act to preserve indoor air quality and energy saving as people are far less likely to turn the ventilation system down to a lower setting due to noise. This package of measures reduces the need for occupants to open windows, though they are free to do so, and consequently helps to minimise energy demand.

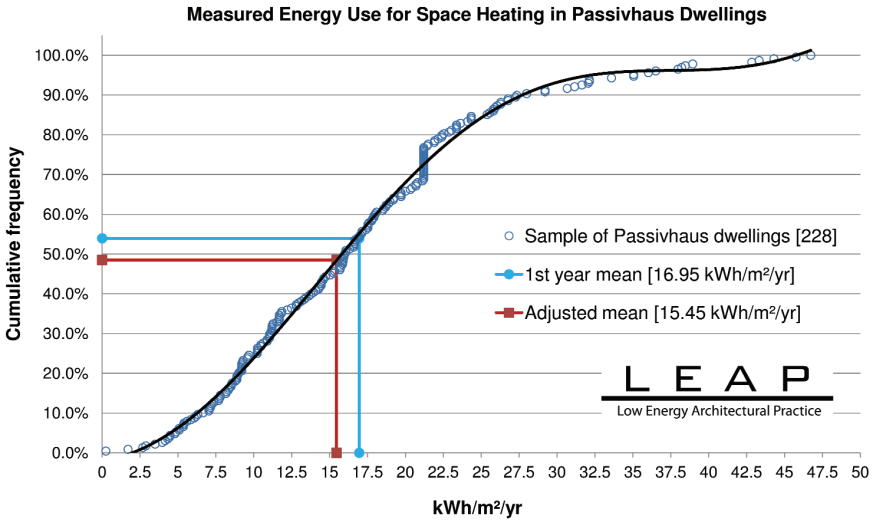

Figure two: a collation of measured energy consumption for 228 certified passive house dwellings

Whilst there's evidence from the continent that suggests that passive buildings do deliver the expected energy efficiency when occupied, and that occupants are generally satisfied, there are still many lessons that we need to learn before we can say that we've closed the performance gap. The reason for this is that building performance evaluations – on a range of building types and to a range of standards – have, time and again, highlighted chronic low level failures that can have an impact upon health and wellbeing, energy use and carbon emissions.

Current performance gaps for new buildings that regularly arise during design and construction processes may be regularly found in areas such as:

1) domestic hot water (design, specification and energy accountancy); the AECB water standards are a good start;
2) lighting; visual quality, views, illuminance, luminance ratios, reflection, spatial geometry, finishes, glare, lighting quality, natural daylight, luminaires, controls, maintenance;
3) fan power; usage and energy demand;
4) equipment and appliances; usage, energy demand and impact upon cooling loads;
5) overheating (risks and mitigation); comfort thresholds, complex interactions between comfort thresholds and other conditions (such as the impact of external noise upon window opening), suitable and practical cooling load reduction strategies, etc.;
6) the functionality and usability of controls, equipment and interfaces; simple and intelligible equipment that offers appropriate feedback/response to the user;
7) duct cleanliness; there are no protocols readily available for use by the building contractor, the client's agent or building control to determine appropriate cleanliness (how clean is clean enough?) Without such guidance health and wellbeing can be compromised;
8) acoustics: Noise arising from natural or mechanical ventilation strategies (the Passive House standard does impose requirements for mechanical systems);
9) hand over, user guides and training; intelligibility, practicality, suitability, relevance; purchase by a new owner perhaps years after the building was built – how will they be trained and informed?
10) maintenance of ventilation systems; suitability of education, training, warning and notification.

These performance gaps are not "passive house problems" but issues that the whole industry must engage with. On the basis of people's willingness to engage with knowledge sharing events, such as open days and conferences, and to undertake energy audits and post occupancy evaluation, I believe the passive house community is well positioned to engage with addressing many ailments affecting building performance and the building industry at large. Feedback – and feedforward – processes really need to become routine and instituted within all working practice.

[1]A number of the papers referred to in this article may be downloaded from: http://leap4.it/Insight-Articles-and-Papers

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Mark Siddall, of LEAP: Low Energy Architectural Practice, is a practicing architect and passive house designer. He has overseen the design and construction of 28 passive house dwellings, including those of the Racecourse Estate, and a number of award winning low energy retrofits that targeted an 80% reduction in carbon emissions. Mark is also a technical advisor to the Passivhaus Trust. To find out more please visit www.leap4.it

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glossary

*Perplexed by all this talk of U-values, blower door tests and embodied energy? This third instalment of our sustainable building glossary will help you get to grips with the key terminology. These entries will be added to an online glossary at **www.passive.ie/glossary**, which will continue to grow in detail as each new issue comes out.*

Air source heat pump This type of heat pump captures heat from outdoor air and uses it to provide space heating or hot water, using electricity to boost the temperature if needed. The warmer it is outside, the more efficient an air source heat pump is and the less electricity it requires.

Building envelope/fabric The exterior 'shell' of the building, including the external walls, windows, ground floor and roof. When designing an energy efficient new build or retrofit, good architects or designers often talk about a "fabric first" approach. This means making sure the building is well insulated, airtight and thermal bridge free — so that as little heat escapes as possible — before thinking about the type and size of heating system to use (boiler, heat pump etc).

Cavity wall A wall with inner and outer masonry layers (eg block or brick), with a cavity in between. The cavity serves as a way to drain water out of the wall. Cavities can be insulated to improve their ability to keep heat in the building, but it's important to ensure this doesn't lead to unintended moisture ingress problems, particularly in wet areas.

Condensing boiler A condensing boiler can re-capture some of the heat normally released in the form of hot gases, and use it to heat up water returning from your central heating system. This means that it requires less energy to produce a given amount of heat, and is therefore more efficient.

Dew point The temperature below which water vapour in the air will start condensing to liquid. This is important in buildings, because anywhere there is a dew point, there is a risk of condensation and mold growth. For example, improperly installing insulation on the inside of a wall can create a dew point between the insulation and the wall.

Exhaust air heat pump This type of heat pump extracts heat from waste air leaving a heating system and uses it to provide hot water or space heating, using electricity to boost the temperature if needed.

Expanded polystyrene (EPS) A type of rigid plastic foam commonly used for insulation. It is a lightweight material, and its insulating value is provided by air trapped within the closed polystyrene cells.

Ground granulated blastfurnace slag (GGBS) A steel-industry by-product that is used instead of traditional portland cement for 'eco' and 'green' cements and concretes. Because GGBS is essentially a by-product of an existing industry, it's considered to have a much lower embodied energy than traditional portland cement

Greywater Wastewater from baths, sinks, dishwashers, washing machines etc - essentially all a house's wastewater except that from toilets and macerators/food grinders

Heat pump A device that takes heat from one location (such as the ground, air, or water) and brings it to another (such as the inside of a building). After extracting heat from the source, heat pumps use electricity to boost the temperature to that required inside.

The efficiency of a heat pump is measured by its coefficient of performance (COP) or seasonal performance factor (SPF). See passive.ie/glossary for definitions of these terms.

Internal insulation Insulation applied to the inside of a building envelope, sometimes called dry lining, though the latter term can describe any dry material applied to a wall (eg plasterboard). Not to be confused with cavity insulation, which is applied between two leafs of a wall.

Joist A joist is one of the horizontal construction elements, typically made of timber, that support a ceiling, roof, or a floor. Insulation materials are often installed between the joists, which run parallel to each other.

Party wall This is a wall shared between two properties

Passive house / Passivhaus Passive house is a rigorous ultra-low energy building standard. Developed in Germany in the early 1990s, the standard has led to the design of buildings that are so energy efficient they don't require conventional heating systems.

Passive houses make the most of free heat wherever possible – whether in the form of passive solar gains through windows, metabolic gains from occupants, or recovering most of the heat that would otherwise be lost venting hot, wet air from cooking or washing.

To be certified by the Passive House Institute, buildings must meet three strict criteria:
1) A space heating demand of no more than 15 kWh/m^2/yr, as calculated using PHPP. An alternative here is if the specific heat loads is 10 w/K or less, though this appears to be at the discretion of the certifier.
2) A primary energy demand of no more than 120 kWh/m^2/yr for ALL domestic energy use – unlike BERs (Ireland) or EPCs (UK) which don't deal with energy use from electrical appliances.
3) An airtightness of no more than 0.6 ACH at 50 Pascals.

Many people in the UK use the original German term "Passivhaus" to distinguish buildings which meet the criteria from those which either have been found to fall short – or weren't even assessed in the first place. Our preference is for passive house. Note that some contributors to this magazine may ordinarily use the German spelling, but we've amended to English for consistency.

Solar gain This refers to the heat energy that a building receives passively from the sun, normally through its glazing. Designing a building so that most of the glazing faces south, with little glazing facing north, is one of the basic principles of passive house design in the northern hemisphere. This helps to reduce the need for mechanical heating systems.

Thermal bypass On this one we'll defer to Mark Siddall, writing here for www.bdonline.co.uk: "Thermal bypass is heat transfer that bypasses the conductive or conductive-radiative heat transfer between two regions. Defined in this manner thermal bypass includes convective loops, air infiltration and wind washing. In this context […] it should be recognised that the term thermal bypass is being applied to largely unfamiliar, and often unregulated, heat transfer. Furthermore it is an acknowledgement that air movement can lead to a significant increase in the heat loss when compared to predicted values. This means that even when the architect, and builder, thinks that a design has addressed the performance requirement it is very likely that it has not." You have been warned…

U-value The U-value of a material is the rate of heat loss through that material. The lower the U-value of a material, the less heat can pass through it and the better it is at insulating. U-values are measured in watts per metre squared kelvin (W/m^{2}K). For a more detailed definition, see passive.ie/glossary

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